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THE
WILDERNESS AND ITS TENANTS

A SERIES OF

GEOGRAPHICAL AND OTHER ESSAYS

ILLUSTRATIVE OF LIFE IN A WILD COUNTRY

TOGETHER WITH

EXPERIENCES AND OBSERVATIONS

CULLED FROM THE GREAT BOOK OF NATURE

IN MANY LANDS

BY

JOHN MADDEN

IN THREE VOLUMES

VOL. II

LONDON
SIMPKIN, MARSHALL, HAMILTON, KENT & CO., LTD.
STATIONERS HALL COURT
1897

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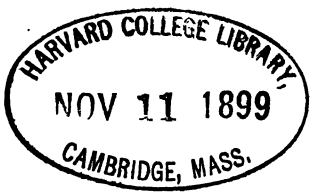

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The Wilderness and Its Tenants.

CHAPTER VIII.

THE REGION OF THE GREAT PLAINS.

Their Geographical Limits and Enormous Extent. Their Climates. The Land of the Lemon Tree. Scriptural Description of Gardens. Why there are no Forests on the Plains. The American Eastern Forest Region. Sudden Cessation of Forest Growths. Resemblance of Great Plains to a Stormy Sea turned into Land. Bird's-eye View of Great Plains. Buttes. Steering a Course across the Grassy Sea. Influence of the Vast Expanse upon the Human Mind. Influence of City Life in Dwarfing the Mental Energies. Necessity for Habits of Observation in a Traveller. Influence of Wide Plains on the History of Nations. The Peopling of the Great West. The Great Buffalo Range of North America. The Plains Indians. The White Man and the Red. Border Warfare. The Pampas. Pampas Indians and Indian Raids. Their Tactics—Driving Loose Horses. Horses as an Article of Food. The Gauchos. The Spanish Barb Horse. Re-introduction of the Horse by the Spaniards. The Fossil Horse of South America. Spanish Cattle. Buffalo Hunting on the North American Plains. Extinction of the Buffalo as a Wild Animal. Skin Hunters—"Taking a Stand." Habits of the Buffalo. Hybrid Buffalo—Their Reputed Excellence. Cattle and Buffalo on the Plains during Blizzards. Buffalo in Snow Time. Reindeer Feeding in Deep Snow. Advent of the Great Snows. Their Condition and Action as a Protection to Vegetation. Ptarmigan or Snow Grouse. Birds flying into Snow Drifts. Climates of the Plains. Sudden Alternations of Heat and Cold. "The Indian Summer" in North America. The Plains Region as a "Health Resort." Climate of the British Islands contrasted with similar Latitudes elsewhere. Climates of Labrador, Canada and Russia. Influence of Climatic Conditions upon the Human Race. Sunstroke rare upon the Plains. Erroneous Accounts of Plains Territory given by the Early Explorers. The Reclamation of Waste Lands by Stock. Springing up of Natural Pasture Grasses. Influence of Novel Pastures upon the Health of Stock. Influence of Great Herds in Modifying Pastures. Cattle and Sheep in Australia. What Can be Done with a Pound of Wool. Saline Rivers

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and Lagoons. "El gran Seco" in Rio La Plata. Why Fresh Waters turn Salt. Wild Animals driven by Thirst. A Hare Drinks out of a Water Vessel held by an Officer. The Plains Rivers. Their Extreme Flatness Exaggerated. Panoramas viewed from Eminences. Mountain Streams Disappearing in the Plain. Timbered Margins of Streams. Crossing Prairie Streams. Sand Streams—Dangerous Nature of. Great Herds of Buffalo lost in Crossing Rivers. Quicksands. Terrible Death in a Quicksand. Swamps. Blind Lakes. Ravines. Malaria in Ravines. "Divides"—Their Importance to Travellers. Buffalo Paths following Divides. River Bottoms. Great Cañons. "The Process of Erosion." Crossing a Cañon. Ancient Passes known to the Indians. Descent into a Cañon. The Great Walls of Rock. Voyage through a Cañon. Sudden Flood in a dry Cañon. Great Lines of Cliffs, or "Bluffs." "Subsidence" as the Creative Power of Bluffs. Natural Terraces. Table Lands. The Great Thibetan and Peruvian Table Lands. The Plains Grasses. Pampas Thistles and Cardoons. The Prairie Indians. Border Wars. Attacks on Emigrant Trains. Border Anecdotes. A Stage Driver in the Apache Country. Frontier Settlers. Indians Following and Watching Waggon Trains. Indian Attacks and Surprises. A Scout's Prophecy. Destruction of General Custer's Command. Barbarities of Savage Warfare. Torture of Prisoners. The Fiery Ordeal. The Solitary Indian on the Plains. The White Man Lost on the Prairie. Indian Military Genius and War Tactics. Honesty in the Repayment of Debts.

THE Region of The Great Plains forms the fourth of the great territorial divisions into which our world is divided—and one of them extends, in either hemisphere, northwards and southwards, beyond the polar margins of the Desert Zones. Their position therefore begins at about the 30th parallel of North and South Latitude, and it may be taken as extending to the 50th parallel. The great plains thus cover an enormous extent of territory, especially in the northern hemisphere—for, as a glance at the map will show, the earth's territorial surface is greatly restricted in area between these parallels in the southern hemisphere, in consequence of the vast preponderance of ocean there. "The Region of The Great Plains" comprise within their boundaries the vast area of steppe, in southern Russia and Asia, which beginning from near the mouth

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of the Danube, extends in an almost unbroken surface to the great wall of China, in the far east. So also in the new world, the celebrated prairie region of North America represents this division there, as do the Pampas in the corresponding position of the southern hemisphere in South America. The Algerian Tell and Plateau Region in North Africa, the great plains of the Cape Colony in South Africa, and the vast pasture country in Australia, all lie within what we have ventured to describe as "The Region of The Great Plains." Here too, some of the most celebrated of the great hunting countries of both the old and especially of the new world were located; where in former days, still within the memory of many persons now living, heavy game of many kinds was to be found, roaming in what would now seem to be incredible numbers. We need only refer to the works of Captain Cornwallis Harris, Mr. Gordon Cumming, and others, to obtain an idea of the vast numbers and variety of animals that were to be found in that sportsman's paradise, the great game country of South Africa. While a mass of literature too numerous even to mention, has described the enormous herds of buffalo that frequented the prairies of the Far West; from which the modern sportsman can form some idea of the magnificence of the sport which used to be enjoyed in these countries in former days. As for ourselves, we have done our best to endeavour to collect numerous curious details and facts respecting them, which will be found elsewhere in this work. *

Unfortunately, what with the introduction of breach-loading firearms, and the increased facilities of communi-

* See the Chapter on "Great Herds of Game" and the section on "Hunting and Shooting on Plains," in Volume iii.

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cation, the buffalo, and other great game of the North American prairies, seem now to be almost extinct; in South Africa too, the heavy game has, in the same way, been gradually driven further and further to the northward, until what remains of it is now rather to be found in the Bush Country, beyond the Desert Zone, than upon the plains to the southward, which used to be their favourite resort.

The climate of the Great Plains, as might be expected in so vast an extent of territory, varies considerably in its character, according to the locality. In the higher latitudes, the winters are often exceedingly severe, but on their equatorial margins the climate naturally partakes more or less of the dry climate of the adjoining Desert Zone, large tracts of these plains becoming desiccated during the summer season; so as to become veritable deserts for the time being.

It is to be understood however, that we have now reached a latitude where we are beyond the influence of the tropical rains, and divided from them by the rainless belt of the Desert Zone. In the Great Plains country, therefore, there is no longer any regular "rainy season," properly so called. We are now in the region of variable rains, and this characteristic becomes gradually more and more marked as we proceed towards the poles. On the side adjoining the desert, the summers are often exceedingly hot and dry; but the approach of winter is generally accompanied by a copious rainfall and a regular cold season. The rains are however of an intermittent character, so that droughts of a serious nature sometimes alternate with floods of an equally disastrous kind; but during favourable seasons all this country is covered with a luxuriant

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vegetation—excellent pasture grasses cover the plains—fine timber also begins to appear along the water courses: indeed this part of the world, from its generally soft and salubrious climate, brilliant sunshine, and more or less abundant rainfall, is capable of being turned into a regular garden, in which under a proper system of cultivation, most of the finest fruits and flowers, and other of the choicest productions of the tropics, can be acclimatized and produced in extraordinary variety and excellence. It is therefore to this portion of the earth's surface that these beautiful lines translated from Goethe may, as we conceive, be held most closely to apply, where he says—

"Know'st thou the land where the lemon trees bloom,
Where the gold orange glows, in the deep thicket's gloom;
Where a wind ever soft, from the blue heaven blows,
And the groves are of laurel, and myrtle, and rose." *

Many striking descriptions are also to be found in The Scriptures, illustrative of the horticultural luxuriance of gardens situated in Bible lands, in the midst of the wide plains of Palestine which form part of what we have designated The Region of the Great Plains in that part of the world, and Solomon the King thus sings of their glories—

"For lo, the winter is past; the rain is over and gone.
The flowers appear upon the earth,
The time of the singing of birds is come:
And the voice of the turtle is heard in our land.
The fig tree putteth forth her green figs,
And the vines with the tender grape give a good smell,
Arise my love, my fair one, and come away." †

* Goethe, *Wilhelm Meister's Apprenticeship*, Book iii., Ch. i. (Bartlett's *Familiar Quotations*).

† *The Song of Solomon*, ch. ii., verses 11 to 13.

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"Until the day break, and the shadows flee away,
I will get me to the mountain of myrrh
And to the hill of frankincense." *

"Thy plants are an orchard of pomegranates, with pleasant fruits;
Camphire with spikenard, spikenard and saffron, with all trees of frankincense;
Myrrh and aloes, with all the chief spices.
A fountain of gardens, a well of living waters, and streams from Lebanon.
Awake, O North wind; and come, thou South;
Blow upon my garden, that the spices thereof may flow out." †

It is, however, not with the luxuriant beauty of their cultivated portions, but rather with these great plains in their sterner aspects, as a wild country, that these volumes more particularly profess to treat.

The bare appearance which the absence of trees from the landscape has imparted to the plains country, and the serious inconvenience which the want of fuel sometimes occasions, has often exercised the minds of geographical observers to discover the reason why trees do not grow there. It is evidently *not* because the land is incapable of growing them; because as soon as trees are planted, and protected by settlers, they are found in general to grow remarkably well. It has therefore sometimes been supposed that the absence of trees is caused by fires, owing to the frequent practice of the natives in the plains countries of firing the grass in the dry season; and it may be that to a certain extent this may sometimes account for their absence; yet trees are to be found growing in so many positions along the banks of streams, and

* *The Song of Solomon*, ch. iv., verse 6.
† *Ibid*, ch. iv., verses 13 to 16.

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other situations, where the fires can, and do, come in among them, that this theory can hardly be accepted as altogether satisfactory. We therefore believe it to be due to certain peculiarities of climate more than to any other cause. Dry and cutting winds, prolonged droughts, the porous nature of the soil, and consequent scarcity of surface water, probably all contribute to produce this result. The erection of buildings, fences, and other shelter, and the fostering care of man, as soon as the country is settled, seem, however, as we have said, sufficient to cause trees to grow where none were ever known to grow before.

But the circumstance which seems to point most strongly to some climatic cause, is the fact, that the neighbourhood of the ocean, and the consequent prevalence of an indraught of water-bearing winds, deprived of the exceedingly dry and cutting nature which characterizes the land breezes, generally has the effect of causing the plains country to disappear, and a land of forests to take its place, not only on the seaboard, but sometimes for a considerable distance inland, in regions which further back consist of entirely open plains. A notable instance of this is found on the eastern seaboard of the United States, the whole of which was formerly a great forest country which extended very often for a great distance inland, and then suddenly from some unexplained cause the forest country ended, and the prairie or plains country took its place, and extended, with almost unbroken sequence to the Rocky Mountains. The same thing is seen on the Pacific coast, and also to a great extent in South America; except in saline districts the "Pampas" rarely reach the coast. In South Africa, and Australia,

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the same rule seems generally to hold good, and where want of water and a sterile soil does not prevent it, the coast line is in general well wooded, either with trees or bush, except where the prevailing winds are very keen.

After traversing the coast region of forest however, one is often surprised to find how suddenly the trees cease, and the wooded country gives place to open grassy plains—the horizon often extending, as at sea, to the sky line, without a single prominent object to catch the eye: so that the resemblance to the ocean, with which every traveller is impressed, is perhaps on the whole often more complete upon the plains than even in the desert—indeed, if we might venture to hazard a guess upon this subject, we should say that great tracts of apparently level country are more common upon the great plains than anywhere else. Those who have travelled much upon the South American "Pampas" can hardly fail to have been struck with the boundless extent of flat plains which are to be met with there.

Nevertheless it would be a great mistake to suppose that such a description conveys a faithful picture of the great plains in general, because in so vast a region almost every variety of country is to be found, and as an enormous area consists of undulating ground, the resemblance to the ocean here frequently reappears by the succession of undulations, very much like the heavy rollers seen upon the sea after a severe gale.

Considerable tracts of level country also occur, dotted over with hillocks, rising abruptly out of the plain, in some cases to a height of 50 or 60 feet; from the crest of one of these eminences, or "buttes" as they are

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called by plains men, a solemn and impressive spectacle may frequently be witnessed, as the eye travels over the boundless expanse, without a single living object to be seen anywhere upon it, which stretches forth in silent and desolate grandeur, until it melts into the sky line. Nowhere can the vastness and solitude of the great plains, and the insignificance of the human atom which crawls across their surface, be more fully realized, than when seen from such a point of vantage. In such a situation, the prairie traveller frequently has to steer his course in the required direction, exactly like the navigating officer of an ocean steamer, bound across the Atlantic; and he will of course ascend one of these eminences occasionally, to observe the lie of the country in advance, to look out for game, and last but not least, it may be, to keep a vigilant watch for signs of a possible human enemy.

In the Indian country this last duty was often a very anxious one, and kept a constant strain upon the faculties. Under no circumstances indeed does the mind become more quickly and efficiently trained to habits of unceasing vigilance and observation. Every little incident, however trivial, is at once noted. Anything in motion at once attracts the eye, and the trained vision of the experienced plainsman will make out objects in the landscape, with unerring certainty, at what seem to the novice incredible distances. Then "following a trail" is so large and difficult a question, that it would require to be specially treated of by itself.

In guiding a course across this grassy sea, wealth, rank, and book learning, count for little. The safety of all depends upon the guidance of the man whom long practice in studying the features of a wild country

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has enabled to read the great book of nature, and to interpret the signs of the wilderness correctly. If hostile natives are hovering round the party, he alone can detect the faintly marked traces of their presence. All other learning will then appear as so much dross, even the untutored savage looking down with open scorn upon the mere man of letters, who without his aid and guidance would be helpless as a child. And thus it often comes to pass, that a journey of considerable duration across wide plains, such as used to be common in the great west, in the days of the Californian emigrant trains, some 30 or 40 years ago, has frequently been known to affect the whole character and cast of thought of a man's subsequent life.

Before the long march, then of *months'* duration, has come to an end, he has acquired a spirit of resource and self-reliance, habits of trained observation which he never afterwards loses, and which frequently prove invaluable to him in after years, if he uses his opportunities aright.

In the turmoil of life in a great city, fashion exercises so powerful an influence that men actually become like a flock of sheep, which "follow their leader." Each man blindly falls in with the prevalent custom, whatever it may be, without questioning—and hence it comes, most probably, that there is perhaps not one man in a thousand who ever exercises the faculty of original thought. In general his ideas are simply a reflexion of the passing craze of the hour, or of his social clique, party, or sect. Hence, we often find in old established communities a particular set of opinions handed down in succession from father to son for many generations, as if they were pieces of family plate, or parcels of real estate.

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The original thinker indeed, when you find him, generally turns out to be somewhat of an eccentric. He must be so in fact, or he would not have ventured to separate himself from his fellows by adopting new and probably unpopular opinions.

Travelling through a new country therefore, where everything is different to what it is at home, often affords, as we venture to believe, the necessary impetus to the mental faculties which makes a man think. There, he must keep his eyes open, and observe, if he would get along at all. This theory would seem to receive a large amount of support from the well-known and remarkably inventive capacity of the American people. It seems hard to come to any other conclusion, than that this genius has been mainly developed by the ready resource which a familiarity with the shifts and expedients of wild life entails.

It was in the western backwoods that Washington learnt his business as a soldier, and laid the foundations of that great reputation which has rendered his name immortal. It was in the great prairie region of the Far West, that almost all the United States Army Officers, who rose to eminence or renown in the Civil War (1861—1866), acquired that military training and experience upon which their subsequent fame was built up. It was there also that most of the European immigrants, who during the present century have gone to America in search of fortune, have turned their footsteps. "Go West, young man," was the universal formula of advice given to these new-comers upon landing on the American shores; and it was in the west that most of the successful men of the present generation have risen from poverty to position and affluence.

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The powerful influence of the Great West upon their national life and character is admitted by all thoughtful Americans, and that it has been the school which has nurtured and produced all that is best and greatest in American character is a fact which few people in the United States will be disposed to deny.

On the other hand, the gathering together of a great population within narrow limits, and the deadening effects which city life produces upon individual character, we cannot but think has had a greater influence upon the history of mankind than is generally supposed: for it paves the way to that decadence in the national spirit which produces the decay, and eventual fall of states; and at the same time it also blunts the senses, and impairs the physique of the individual man brought up under such conditions.

We will take just one single point as an illustration of this. We allude to the widespread prevalence of "myopia" (short-sight) in the London Board Schools. Now this is an all-important fact from a national point of view; namely that *over 60 per cent* of the children attending the Public Elementary Schools of the British Metropolis have defective vision. To speak with greater accuracy, out of 8125 children, whose eyes were examined by order of The Education Department, only 3181 children of both sexes, or 39.15 per cent of the whole, were possessed of normal vision of both eyes. On this subject Mr. Brudenell Carter, the well-known oculist, makes the following comments (necessarily greatly abbreviated) in his report:

"I feel certain that this (defective vision) must be attributed chiefly, if not entirely, to the conditions of their lives and surroundings. The visual power of London children is not

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cultivated by their environment. They see the other side of the street, and the carts and omnibuses of the thoroughfares, but they scarcely ever have the visual attention drawn to any object difficult to see. A country child has an expanse of landscape before him, presenting numerous objects rendered small by distance, many of them disguised by resemblance in colour to their surroundings, and requiring close scrutiny in order that they may be distinguished, and so the country child is not affected in the same degree by this subnormal power of sight." *

Now contrast these observations with what we have to say upon the marvellously acute vision of some of the wild tribes among the Arabs and the Prairie Indians; and see how the narrow, squalid influences of a city life cramps and mars the natural gifts conferred by a beneficent Nature upon her children.

This digression into questions of historical and political polemics not unnaturally arises when we consider the extraordinary rapidity with which what was so recently "The Wild West" is being settled, and filled up, by swarms of emigrants from all quarters, and what an important influence such a result is sure to exercise upon the future of the human race.

The whole of the great prairie region of North America is in fact now parcelled out into states and territories, all of which possess a rapidly growing population; where 30 years ago, there was no one, and where in place of human populations, immense herds of buffalo ranged over tracts of wild country of then unknown and boundless extent; a great deal of which had rarely or never been traversed by the foot of the White man.

* Precis of Extract from Article in the *Times* of July 17, 1896, p. 8, on "Defective Vision in the Public Schools." (Mr. Carter even goes so far as to advise "*Seeing Competitions*" as a corrective for these grave defects of vision.)

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So little indeed was then known about this great region, that it was generally supposed that it would never become habitable, by anything but the buffalo and wandering bands of wild Indians, who were continually roaming over this mighty wilderness, and warring with each other, and with everyone not a recognised member of their own tribe.

The Whites clearly saw that this unsettled state of things would necessarily continue to exist as long as the Indians themselves existed, because as these wild tribes lived entirely upon the proceeds of the chase, they naturally resented the intrusion of strangers into their hunting grounds, or even their passage by beaten trails across the plains. Everyone who ventured to explore, or hunt over their lands, therefore, did so at the peril of his "scalp," and if a small party was overpowered by a sudden attack of a superior force of Indians, to be killed in battle was the very best and happiest thing that could happen; for all who fell alive into the hands of these ruthless warriors were usually put to death after undergoing an ordeal of torture frightful to contemplate. Neither age nor sex was of any avail to mitigate the fate of the unfortunate white who unhappily fell into their power. Women, it is true, formed occasional exceptions; but only after submitting to a course of nameless outrages, after which they were at length occasionally received as members of the tribe, as the wives of their red captors; but generally in the end, as soon as the Indians were tired of them, they too were put to death.

The pitiless warfare that this state of things produced between the Indians and the Whites may be better imagined than described. As a rule no quarter was

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asked, or granted, on either side. Indeed the saying (which we have frequently heard expressed) that, "the only good Indian, is a dead Indian," had at one time become a regular western proverb. Of course there could be but one ending to this state of things. The Whites, constantly recruited by fresh arrivals of bands of adventurous men, and armed with the improved form of modern long range firearms, soon made short work of the Red Skins; who, with the exception of a few degraded remnants of their wild and warlike forefathers, have now mostly followed the buffalo, to what, let us hope, may prove "the happy hunting grounds" of another and a better country. Meanwhile the conquering flood of pale-faced warriors has surged continuously onward, till it has overspread The Region of The Great Plains from sea to sea, in North America.

The same result has to a great extent followed upon the Pampas in South America. The word "Pampas" being simply the Spanish for "Prairies." The Indians of the South were here bad enough too, at one time, and it was very dangerous at certain seasons of the year to cross some districts of country, owing to the incursions of large bands of these wild people from the southwards. They, too, killed everyone they met, and carried off all cattle and horses belonging to the settlers that they could lay hands on, in the same way as their fiercer and more warlike namesakes used to do in North America. But the Indians of The Pampas could never be compared either in numbers, or warlike skill, to those of The Prairies; though they proved troublesome enough to the feeble governments and slender resources of the South American Republics. The warrior plainsmen and Indian fighters

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of the North would probably have swept them out of existence in one or two campaigns, or else would have taken such order of them that they would have been mighty glad to "make a peace," and keep it, for many a long day afterwards. This we believe, is always the best and most humane policy in savage warfare in the long run. *Force* is the only thing the red savage, or the oriental native respects. A soft, milk-and-water, half-hearted course of action, is always put down to fear, and never to a desire to do justice or to show mercy. Such a policy is not even understood.

A great deal of the plains country to the southwards of the main lines of communication from Buenos Ayres to Mendoza upon the Pampas still remains unsettled, and owing to the brackish and even salt nature of the rivers, will probably remain so for many years to come. It was from this country that the Patagonian Indians used to issue, when they made their incursions upon the settlers, and after effecting a valuable seizure they used instantly to retire into its solitudes, driving the captured stock before them, rapidly and by forced marches at first, and as the chances of pursuit diminished, they slackened their pace, and leisurely retired to their fastnesses in the unknown wilderness to the southwards. These tactics are almost identical with those of the Prairie Indians in Texas, and elsewhere in North America, and like them too, they were capable of wonderful feats of horsemanship; the distances for instance, which they have been known to accomplish, within twenty-four hours, when closely pursued have sometimes been such as would appear almost incredible. On horseback in fact these Indians were able to do almost anything; and when well

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mounted formed skilful and formidable adversaries; but on foot they became comparatively helpless, being indifferent walkers, both slow and awkward in their movements. It was their habit, when on a foray, to drive a number of spare horses along with them. Experience has shown that in a wild country, where grass is plentiful, this can always be accomplished without difficulty, horses being under such circumstances very gregarious, so that there is little danger of their getting lost, or straying, an instinctive dread of the danger of being separated from their party and left behind causing them to keep together as much as possible on the high plains. A horse left behind, will in fact gallop wildly after the others, until he comes up with them again. When animals run off, therefore, they generally do so in a body, in consequence of a sudden panic, causing a stampede. This is a subject however, concerning which we shall have more to say hereafter. Suffice it to say at present, that Indians for these reasons rarely or never experience any difficulty, in driving along with them a sufficient number of remounts, in case of accident to their horses.

The Pampas Indians of South America also eat horse flesh with as great a relish as we do beef; and live, whilst on a foray, almost entirely upon mares' flesh. A number of these animals therefore, are always brought with them, as slaughter cattle, so that they are never impeded in their movements by commissariat difficulties. The comparative scarcity of game on the Pampas render some arrangement of this kind a matter of imperative necessity; but these Indians are thus enabled to travel quickly, and without encumbrance of any kind, for days or even weeks together, and in

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this respect, it struck us that they formed the raw material for the most mobile light cavalry in the world.

Many of the "Gauchos" (the white plainsmen of the Pampas) will also eat mares' flesh, following the Indian custom in this respect; and some of them are even said to prefer certain cuts of it to beef; but apart from all sentimental considerations, horseflesh has a peculiar flavour that renders it distasteful to the European palate; still it is by no means bad, and is quite eatable, on a pinch. On the great plains of South America, where horses are so cheap and numerous, mares are rarely used as beasts of burden; many natives considering it cruel to work them, even in a country where sentimentality of this kind can hardly be said to be prevalent, and mares instead of being worked are killed. No doubt their supposed inferiority, and also the enormous numbers of horses of all descriptions has led to this practice of slaughtering these animals, for the value of their hides, fat, and bones. In the great "Saladeros" of Buenos Ayres and elsewhere mares were formerly slaughtered by thousands, and probably are so still, just for the value of the animal products of the carcase, though each of them would, if landed in Europe, represent a value in most cases, of from £20 to £40, and even £50. Cattle were also killed in the same way, and their flesh was salted, dried and turned into "Charqui," a hard indigestible substance like leather, but which was very useful for travellers crossing the pampas, and which we have often eaten.

Nothing astonishes a new comer to the Plate River more than this extraordinary waste of valuable stock, by the wholesale destruction of mares, and a curious fact in connection with the natural history of the horse,

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and the rapid increase of these animals in South America, is also worthy to be noted. For when the Spaniards first landed on the Plate River, (about 1515) the horse did not then exist in South America; yet the recent discovery of the bones of an ancient fossil horse proves that in remote times horses had existed there, but from some cause, not now apparent, became extinct, until re-introduced by the Spaniards. It is to them therefore that the honour of stocking the New World with both horses and cattle, is justly due: the horse of the pampas, which thus far has not been much changed by the admixture of foreign blood, still retains all the characteristics of its Spanish origin, and remains to all intents and purposes a "Spanish Barb."

Then, on the bovine side, the wild cattle of Texas, both in appearance and disposition, still exhibit strong traces of their Iberian extraction, as indeed the whole of the native cattle may be said to do, throughout La Plata and other parts of South America, and also in Mexico, Texas, California, etc., where they have not yet been graded by the admixture of short-horn blood.

On the other hand, the far-famed Buffalo of the North American prairies is now practically extinct in its wild state, and must henceforth be struck off the game list of the prairie country. In the chapter on great herds of game however, details will be found, giving an idea of the vast numbers in which this splendid animal used, within quite recent years, to roam over the then supposed boundless Western Wilds. For we have the high authority of Colonel Dodge, U.S.A., for asserting that, up to "1871-2 there was apparently no limit to the number of buffalo." *

* *Our Wild Indians*, by Col. R. J. Dodge, U.S.A., 1882, p. 294.

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Those who, like the writer, have had the privilege of taking part in the glorious sport of buffalo hunting, in its palmy days, will however probably always look back upon those grand scenes in a hunter's life with mingled feelings of both pride and sorrow. These things are always a source of pleasure to look upon, (a pleasure which endures as long as life itself shall last,) but in this case are unfortunately mingled with regret, for it is grievous to every true sportsman to think of the wicked and wholesale slaughter of millions of these magnificent animals by avaricious traders, simply for the paltry lucre of their robes. "During 1872-3-4," for instance, according to Col. Dodge, "at least five millions were slaughtered for their hides."*

Parties of professional "skin hunters" used then to be sent out regularly equipped for the slaughter. These men used to follow the herds and encamp in some quiet nook where buffalo were plentiful; they used then to creep up to the unsuspecting animals, and the work of slaughter began. One of these men has been known to take post at some convenient "stand," as they called it, from whence he opened fire, and killed buffalo after buffalo, without shifting his position, until the ground was literally covered with the slain, whilst numbers of wounded animals hobbled away to die a lingering death, or become the prey of the white wolf etc., before the herd, at length taking fright, took to their heels and made off.

It is a curious circumstance that these usually extremely wild and wary animals should stupidly stand and allow themselves to be made a target of in this way: but there can be little doubt that they take the

* *Our Wild Indians*, by Col. R. J. Dodge, U.S.A., 1882 p. 294.

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report of firearms for thunder, or other electrical phenomena, which are exceedingly common on the plains. The eyesight of the buffalo was never very keen, and it may be that the masses of shaggy hair that overhung his brows impeded his vision; but however this may be, provided a man did not show himself too openly, and took care to approach the herd from the leeward side, so that they could not catch his wind, buffalo seldom took fright at mere sounds, of which they knew not the import; but preferred to manœuvre round, until they obtained its wind, after which they immediately made off. In the chapters on hunting and shooting these matters will be more fully discussed; and we shall not fail to show how exceedingly keen was the sense of smell in these great animals, who almost always, in common with many others, trusted to their nose to give timely warning of the approach of enemies.

In passing from this subject however we think it desirable to mention that the name "buffalo" is in this case apt to offend the ears of the scientific naturalist, because he regards him as a "bison" (*Bos Americanus*) and not as a "buffalo;" nevertheless we bow to public opinion, and still continue to speak of him as "buffalo," for as "buffalo" we have hunted him, as "buffalo" he was known all over the hunting grounds of the great west, and as "buffalo" he will live in story—for the story of the wild buffalo, and his wild companion the Red Indian, is one which we venture to predict will live on throughout the ages, when the name of the last buffalo hunter has been for ever forgotten.

And here, though the subject is perhaps not strictly

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germane to that of The Wilderness and its Tenants, we must find room for a few words respecting the last gift and legacy of the wild buffalo to posterity—we refer to the matter of "buffalo cattle."

These animals, which we still hope may yet cut a great figure in the world's history, are the legacy of the buffalo cow; the progeny of the buffalo bull and the domestic cow has, we believe, always failed, as owing to the size and shape of the calf the cow was unable to produce it; this led to the loss of both mother and offspring; but the calf of the buffalo cow, and domestic bull, was easily reared, and the result is a new breed of cattle, of which great things are expected.

A long account of a herd of these cattle (said to be the only one then existing) appeared in the American sporting paper, *Forest and Stream* of April 18, 1889. They were reared by the Hon. C. S. Jones, of Garden County, Kansas, and the report states that,—

"None of the good things we have heard of these cattle has done justice to their superb appearance," they were mostly the produce of buffalo cows roped upon the plains, when 3 or 4 weeks old, from 1885 to 1888. The half bred animal is stated to be "built just on the lines of a beef maker, and yet the picture" (portrait of cow given with the paper) "conveys only a faint idea of the excellence of this superb creature. She is very tall, very thick through, and with a gigantic frame, and thick, short legs. The cows are all alike and convey the impression of more bulk than large work-oxen, and were estimated to weigh 1400 lbs."—"a half-bred steer was killed when three years old, and dressed 1280 lbs. clear meat, or nearly twice as much as a fat four year old steer. As might be expected the three-quarter breeds more nearly resemble the buffalo in hump, head, and horns,

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while the coat is much longer and more wavy than the half-breeds. A young three-quarter bred bull, at three years old, pulled down the scale at 2400 lbs., when grass-fed in autumn. They produce a robe, in beauty and evenness superior to that of the buffalo, everywhere a beautiful rich brown, and as heavy as any buffalo robe. The robe of the half-breeds is even in length on all parts, and without curl, like a heavy bear skin." *

But there are other qualities which should strongly commend these animals to the attention of the agricultural world, namely, the extreme hardiness which they have inherited from their wild forefathers.

The losses which have sometimes been sustained by stockmen in the United States, Canada, and Australia, by severe storms of icy winds known as "Blizzards," are well known, and are referred to in some detail in other portions of this work. † If we can rely upon the accounts given in *Forest and Stream*, from which we have quoted, however, the hybrid buffalo cattle seem made to meet this difficulty, which we apprehend is one which will always make itself more or less felt upon wide plains, towards the polar side of this zone. Even so far South as Texas, these storms are at times exceedingly severe and destructive, and under the name of "Northers," are much dreaded by the inhabitants, as we have already shown. § According to the author of *Forest and Stream*,

"In severe storms" (Blizzards) "domestic cattle turn tail to the wind" (and are unable to face it). "Buffalo do just the reverse—they face the storm, and work up against it. This

* From American Sporting Paper *Forest and Stream*, of April 18, 1889.

† See our Section on Climates and Temperatures. Vol. i, Chapt. iv.

§ *Ibid.*

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characteristic they transmit to their half-breed descendants by ordinary domestic cattle. Often during a storm, buffalo and hybrids, will lie down, turning their shoulders to the gale, and bending their heads round to the flank, so as to be out of the wind; thus they will lie for hours till quite covered up and concealed by snow; and often after a heavy storm, the whole plain being covered with a glittering mass of snow, the only thing to be seen of them is here and there little moulds, beneath which the buffalo lie buried; and one by one they get up, shake themselves, and begin to paw the snow" (or shovel it with their noses) "and feed on the grass beneath—the keen scent of the buffalo enabling them to discover by it where the best grass is to be found." *

We think we can say that in all probability, these details are on the whole substantially correct: as it is a fact which was well known to all hunters on the prairies that buffalo did not run before a storm, as domestic cattle and horses will always do if they can; and experience has shown that these latter, and even man himself, when exposed to the full fury of the elements, are on these occasions almost sure to perish, if caught in the open, in really bad storms.

The number of distressing and fatal accidents that have occurred upon the western plains of North America, and elsewhere, from these causes, are almost too numerous to mention; and when a man escapes with his life, it is only too often with frozen limbs, from which fearful mutilations frequently occur. We have ourselves seen more than one instance where a man has lost both his feet.

Now the range of the buffalo extended from the borders of Mexico in the south, to far up into the snowy regions of the Hudson's Bay Territory in the

* From *Forest and Stream*, of April 18, 1889.

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north: how far it may have gone in this direction we hardly think has ever been accurately ascertained; but at any rate it extended as far as the limits of agriculture are ever likely to be carried. In our own day buffalo were exceedingly numerous all over this country: numbers of them were killed throughout the coldest winters, near Fort Edmonton, a celebrated post of the Hudson's Bay Company, on the north branch of the Saskatchewan River, situated in latitude 53°32′ N., longitude 113°5′ W.; and we have always understood from traders and trappers who frequented these wild regions, that buffalo were occasionally to be found far to the northward of that place; in regions where the rigorous cold was almost perpetual, and where these icy winds were common. In fact, there can be no doubt that the buffalo often made its way beyond the limits of "The Region of the Great Plains," into the open glades of our next division, "The Great Forest Region of the Temperate Zone," which bends far to the northward in this direction.

Throughout the long winters, a mantle of snow, many feet in depth, we need hardly say, buried all this great wilderness country for many months in every year; and it is indeed a wonderful and remarkable fact in natural history, to think that a large grass-feeding animal like the buffalo could possibly maintain itself throughout the arctic cold of the long nights in that intensely rigorous season. The fact, at all events, speaks volumes for the extreme hardiness of that noble animal, whose extinction from its native wilds can never be too long, or too deeply regretted.

So far as we could gather, the buffalo did not usually seek its food by pawing, or burrowing in the snow

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with its forefeet, like the reindeer, but rather by shovelling with its broad and powerful nose; and that it did make its way down to the grass, and did sustain its mighty frame in fairly good condition, even under stress of all these accumulated difficulties, there is ample evidence to prove. We may perhaps be pardoned if we here venture to point out how this came to be possible, though this is a matter more properly dealt with in our arctic section.

When the great snows descend during the course of winter in a sub-arctic climate, vast accumulations soon form, as the intense cold of course prevents the snow from thawing, and it therefore remains in a perfectly dry state in the form of a powder as fine as flour, which will brush off clothes like ordinary dust, without adhering to them, or wetting them. Under great cold, snow does not consist of large flakes and crystals, such as we are accustomed to in our own country, but rather of dust, which will not cake together; indeed in all this great region of which we now speak, it is doubtful whether it would be possible to make a single snowball—the snow is too dry for that.

Such being the condition of the snow, therefore, it is easy to conceive that it is possible that animals can make their way through it to the ground, and obtain food in a way which would not be possible were it in a heavy compressed or half melted state.—It is also probable that this is one of those wonderful and beautiful provisions of Nature specially intended to act as a means whereby plants and animals might be enabled to exist in these desolate regions—where the snow itself, which covers all things deep in its glittering mantle, acts as a dress, or covering, to protect the

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earth, and that which lives thereon, from the effects of intense cold.

Nothing that is done by Nature, we may depend upon it, is done except as part of one grand and homogeneous design, no part of which is without its uses.

It is in this way for instance that the ptarmigan, or snow grouse, whose habitat is known to extend beyond the highest latitude yet reached by arctic explorers, actually finds a refuge and a habitation within the snow drift; for if alarmed they will fly fearlessly right into it, and are then and there buried out of sight, like a rifle bullet, in an instant, but without, be it observed, sustaining any injury, even to the feathers, owing to the condition of the snow, of which we have here spoken. Further details of we trust both an instructive and an interesting nature will be found respecting these, and kindred subjects, in our arctic section.

The most noteworthy features of the climate, throughout "the region of the great plains," are its extreme variability and great range of thermometric temperature, which according to the seasons are almost everywhere met with.

The traveller cannot proceed far beyond the limits of the desert zone without becoming aware that he has passed out of the region of cloudless skies and constant brilliant sunshine. In this damper climate, except during the summer season, or where it actually adjoins the rainless region, more or less cloud is generally present in the sky, and rains are liable to occur suddenly at any time of year. The alternations of heat and cold, too, become rapidly more and more clearly marked as the traveller moves away from the

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regions of the sun. Mild and balmy though the climate upon the plains may generally be towards its equatorial margin, its alternations are elsewhere almost always very great; the summers, even far up towards the polar circles, being generally very hot; and the winters correspondingly cold; but at all seasons sudden variations of temperature are always liable to occur. Thus, the heats of summer will be suddenly found to change to cold; on the other hand, even during the severest winters, mild days will occasionally intervene; the springs and autumns too are apt to alternate with periods of hot and cold weather, which are sometimes very trying. A good, and generally well marked illustration of this may be found in what is called in America "The Indian Summer." This occurs during the "fall," or autumn, and is often preceded by periods of considerable cold: when suddenly the scene changes, and summer appears to come back again; a balmy softness fills the air, while the horizon is generally somewhat obscured by a species of smoky haze. This condition of things may continue for periods varying from a few days to a fortnight, or more; after which the breaking up of the Indian Summer is generally the precursor of wintry weather.

Notwithstanding its changeable character, and the sudden alternations of hot and cold periods, the climate throughout the region of the great plains may be described on the whole as peculiarly healthy; and malarial diseases of malignant type may be said hardly to exist here. We do not mean to say that incautious exposure during hot weather, to the miasma of swampy districts, may be practised with impunity; but even there, fevers of malarial origin, when they do occur,

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are mostly of an intermittent character, and the severer forms of bilious remittent, are seldom seen. * On the other hand, as might be expected, rheumatism, and pulmonary affections become more prevalent. Still with due precaution to guard against chills, that great first cause of most of the ordinary forms of serious illness, it may be fairly said that in no other part of the world can the European traveller reside and move about at all seasons of the year with better prospects of preserving that greatest of all blessings, robust health, than he can upon the open and breezy plains comprised within this great region. It is here that the white man may be said to have attained his highest intellectual and physical development—and in connection with this latter fact, we think that the English-speaking peoples may look upon it as a matter for legitimate pride and thankfulness, when they consider the enormous extent of territory occupied and inhabited by their race within this favoured region. There can hardly be a doubt that by far the largest portion of its richest and finest country is comprised within the limits of these English-speaking lands. We note the fact, however, without the slightest desire either to excite international jealousies, or to depreciate the territories of other nationalities; but in doing so it will doubtless have struck the reader that the greater part of the British Islands themselves lie outside, and to the North, of this great and favoured region, and

* It is remarkable that the *first* settlers in many parts of America suffered severely from fever and ague in a way that succeeding generations have not done. There can be no doubt that the cause of this was turning up of virgin soil wherein the malarial germs had accumulated through the ages—but once exposed to the sun and air these germs became so diluted as to become almost innocuous.

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therefore would presumably be excluded from many of its advantages, and yet this is not so, for this drawback is more than compensated for by exceptional and peculiarly favourable climatic conditions, caused, as it is generally supposed, by the set of the Gulf Stream, which to all intents and purposes has the effect of so far modifying the rigour of its northern position, that it enjoys almost all the benefits which would accrue from a much more southern situation. The fact is so well known that we think it sufficient merely to mention it, as a complete answer to such an objection. Had this not been so, it is to be feared that Great Britain would never have attained to that pre-eminent position assigned to her by history: the effects of climate upon both the mental and physical condition of man being such, that the world's history shows it has generally been decisive in this respect.

The condition of Labrador, which occupies on the opposite side of the Atlantic, a similar position to that of Great Britain, furnishes us with a good example of what climate may do to prevent the material progress of a country. Here, it so happens that climatic influences are *unfavourable*, the icy current from the Polar seas making it rigorous in the extreme. As a consequence Labrador has been excluded from all material progress, and remains a nearly uninhabited region of lakes, swamps, and rocky wilderness, ice-bound for the greater part of every year. So far as is known, very little of it appears to be improveable, for the conditions necessary for the formation of humus, or vegetable soil, are generally non-existent.

But so long as the climate is not too severe for the cultivation of the principal cereals, and the raising of

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cattle and other domestic stock, extremely rigorous winters do not seem to place a bar upon the rapid progress of a country, as the history of Canada, and especially of Manitoba, conclusively shows. Nevertheless the slow progress of Russia proves the unfavourable influence which the sealing up of the great rivers and ports by ice, for several months in each year, is sure to exercise. Here we find a gigantic population, together with enormous resources, in their surplus products of grain, horses, cattle, etc., etc.—and an explanation, in a nutshell, as it were, of the aggressive character of Russian policy. Her statesmen are aware of this; the weak point in the position of Russia is the insecurity of her lines of communication with the ocean: and the consequence is, they are never at rest; but are constantly endeavouring to break through this iron girdle of frost, and of confined outlets to the open sea, which is strangling the commercial prospects of their country. Aggression against Turkey has thus always formed part of the policy of Russia, in the hope of obtaining command of the Bosphorus. It therefore becomes a question whether public policy does not point to the admission of Russia to the free navigation of the seas, like other nations occupying more favourable geographical positions.

It would be easy to go on to show, did time and space admit of it, that the moral and intellectual progress of nations is no less dependent upon climate, than is the vegetation, and the produce of the soil.

Man in his highest condition of mental and physical advancement seems to be unfitted for continued residence under the influence of either excessive heat or cold, without the vigour of the race being impaired.

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The heat to which we here refer is that of a tropical character, where high temperatures are constant throughout the year; high summer temperatures merely, do not seem to exercise a permanently debilitating effect, or to impair in any serious degree the national vigour of the race. Thus in Australia, the United States, and elsewhere, the sun temperatures in the hot weather are often very extreme; yet the solar rays seem to a great degree to have lost their power of inflicting serious harm, and the more acute forms of dysentery and hepatic disease are seldom met with. Sunstroke also is rarely to be dreaded, except in cases where excess in alcoholic stimulants, or starting upon a journey with an empty stomach, has predisposed the individual to its effects; and we believe we should not be far wrong in asserting that most of the cases of sunstroke, heat apoplexy, etc., which occur in the great cities, or during the march of military forces in the temperate zones, may be traced to over-indulgence in this respect, perhaps during the previous night; combined, it may be, in the case of persons of the humbler classes, with exposure to the sun on an empty stomach. The experiences of settlers in Australia and South Africa, or on the plains of Texas, and other places, where the summers are very hot, seem pretty well unanimous in admitting that though often very trying, the hot weather in those countries rarely exercises any seriously prejudicial effect upon the health; and instances are common of Europeans who have emigrated, and resided there for years, without their health being in any way impaired though constantly exposed to the sun, in the great heats.

We have laid some stress upon these points because of the number of enterprising young persons who are

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constantly leaving our shores to seek a home in those lands, where many splendid fortunes have been realized in the cattle and sheep farming business; and though circumstances do not now warrant the expectation of such rapid and signal successes as in former days (say thirty or forty years ago), still there can be little doubt that with patience, perseverance, and prudence, combined with fair health and business capacity, much money is still to be made there.

It should not be forgotten that the region of the Great Plains still remains what it always has been, one of the finest, healthiest, and most fertile on earth; yet remarkable is the fact that it is only during the last half century that this seems to have been realized. Fifty years ago most of these exhaustless territories were simply known as the great hunting grounds of the world, where wild beasts, and wilder men, roamed, lords of all that they surveyed—and when we reflect what great things have been accomplished in that brief period, in the way of settlement and improvement, it is surely not unreasonable to suppose that still greater things yet remain to be done; and that whatever fortunes have heretofore been realized there, they may very safely be accounted as small compared with those which in a hundred ways yet wait to be realized.

Another of the remarkable facts to which we desire to call attention is the enormous extent of territory which was at first, after a cursory inspection, set down as desert unfit for the habitation of man, but which has subsequently by human skill and labour been turned into remunerative pasture, and even arable land. The most contradictory accounts in fact were often brought in respecting the same section of country: one party

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of explorers describing it as a series of lagoons and swamps, and the next, as a waterless waste, where the traveller incurred the risk of perishing by thirst or starvation; and yet both reports were probably honest, and given in accordance with what was actually the then state of the locality, as seen by the explorers.

Nor will these discrepancies surprise any experienced plainsman, for he knows that these apparently opposite conditions depend upon the seasons, and that heavy and continuous rains, on these plains, will of course produce floods; while during the dry season the waters will often either wholly disappear, or else will sometimes turn salt, and become undrinkable. Much loss and suffering, and many sad casualties, have occurred both to unwary travellers, stock farmers, and others, either through ignorance or forgetfulness of these phenomena, which may be regarded as characteristic of the climate throughout the greater portion of the Region of the Great Plains. Everywhere in the interior of great continents where these great plains exist, as a rule we may expect that periods of flood will occasionally be found to alternate with prolonged droughts.

Australia seems to be peculiarly subject to be affected by these troubles. We cannot doubt that this is due to the peculiar set of the winds, to which we have already referred elsewhere; * and the losses of stock, etc., which have been sustained on these occasions, have frequently proved of the most serious nature. The floods, though sometimes exceedingly destructive, do not, however, seem to create the same wide-spread disastrous consequences as the droughts. These prolonged droughts seem to recur periodically at inter-

* See the Chapter on Climates and Temperatures. (Chapt. iv, Vol. i.)

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vals of a few years, and sometimes have been known to continue for two or three years in succession. Thus—"hardly any rain fell in the years 1814 and 1815—and again in 1827, 1828, and 1829, there was a long period of drought, during which the beds of deep and rapid streams became dry for miles; every blade of grass was destroyed over large tracts of country, and cattle perished by thousands." *

The remedy for this state of things in the inhabited districts is the artificial storage of water by means of dams, etc. which in many places has proved most successful.

Experience has shewn that human skill and enterprise are capable, when scientifically directed, of triumphing over apparently insuperable difficulties; and that a sure but gradual change for the better is brought about by stocking and human occupation. That an immense area of waste lands, which were at first believed to be irreclaimable, have been already improved and rendered productive, throughout the great plains in the interior of Australia, is a fact so well known as hardly to need repetition.

These lands, up to the time of their occupation, had lain throughout the ages untenanted, and practically untrodden by heavy beasts of any kind. The poverty of the Australian fauna, in this respect, is well known, both the horse and the ox, as well as the sheep, having been introduced by human agency. The benefits which the importation of these quadrupeds was destined to confer upon Australia, were incalculable.

"Under the ceaseless tread of myriads of hoofs, the loose

* Stanford's *Compendium of Geography and Travel for Australia*, edited by Alfred R. Wallace, 1879, p. 34.

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open soil was to become firm and hard; whilst fresh growths of herbs and grass, followed the footsteps of the invading herds. The shaking bogs were soon to be solidified, and the waters that permeated them, to retreat into well-defined chains of ponds and lagoons." *

Nevertheless, the naturalization of these great herds of domestic creatures upon the virgin pasture lands of the great continent of the south, proved by no means the easy task that it might at first sight appear to be; for the herbage in many parts of the country was exceedingly coarse and wiry, and proved but indifferently suited for grazing purposes; and it was necessary for the stock to become used to feeding on these new kinds of pasture grasses, before they could be expected to thrive upon them. Then, there was the constantly recurring difficulty as to the water-supply; and as the water pools dried up, whole districts of country required to be evacuated in haste.

By degrees, however, these difficulties one by one were surmounted, and upon what sometimes appeared the very unpromising herbage and shrubs of the great plains of the interior, stock was eventually found to fatten admirably, and an improved class of herbage seemed to spring up upon the feeding ranges of the great stock farms, sometimes, no doubt, because the seeds of well-known valuable fodder plants, were imported, and sown broadcast over the country; but to a great extent also through natural causes; for pastures closely cropped by large herds of cattle, etc., are known gradually to become modified in character—certain grasses and weeds disappearing, whilst others seem to come up to take

* *The History of Australian Exploration*, by Ernest Favenac, p. 56 (published Sydney, N.S.W., 1888).

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their places: possibly to a great extent, by the larger and coarser grasses being kept down, so that the dwarfer, and more valuable kinds of herbage are enabled to spring up and supplant them.

Also, when stock had once become used to the peculiar vegetation of the Australian plains, it was found that Nature had endowed it with certain special qualities of an exceedingly valuable character, for these—

"Grasses and herbs growing on the table lands, while repellant in appearance and colour, compared to the richer herbage of the coast, possess qualities that render them invaluable as fodder plants. Once let the grasses of the coast lose their moisture, by drought, and they become sapless and worthless; but it is not so on the table lands: months of dry weather have no effect upon the fattening properties of the shrubs; the stock however require to become used to feeding on them, before their full value is attained." *

Such being the result of Australian experience, thus far, we may leave this subject to settle itself, confident in the advent of a splendid future for that continent, where millions of acres yet await discovery and occupation. For a new country, and wild lands, for several reasons, it seems to be generally conceded that cattle, *at first*, do better than sheep. They require less attention, and fewer men to look after them; while for those who are fond of a stirring existence in a new country, the wild free life of a stockman presents greater attractions than that of a sheep-farmer. Also, "Cattle require less outlay, in the beginning, than sheep," and "10,000 acres will carry about 2000 cattle" † (that is to say about one head for every five acres under

* *The History of Australian Exploration*, by Ernest Favenac, Sydney, 1888, pp. 40 and 41.

† See Silver's '*Graziers' Guide for Cattle in Australia*, 1881, p. 17, etc.

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ordinary circumstances). Finally, it is said that "The Hereford breed of cattle has done best" (as stock improvers) "in Australia—Devons next, then Shorthorns" *—and by the last returns, it would appear that the flocks of Australia now number nearly 12 millions of cattle, close upon 100 millions of sheep, and considerably above 1½ millions of horses. †

The great cattle-farming state is Queensland; about half of its area is stated to be "natural forest," most of which is bush country. The remainder is plains country, and "a large proportion of the colony is leased in squatting runs for pastoral purposes, amounting to nearly 270 millions of acres in 1894, when the number of runs was 5577, and the stock of cattle over 7 millions, and of horses nearly 450,000." §

We ought to state however, that several experienced Australians with whom we have had the pleasure of conferring strongly maintain that at present there is more money to be made by sheep than by cattle. These gentlemen were however themselves mostly sheep-owners, and so may have had a certain amount of predilection for these beautiful little creatures, "whose feet" according to the saying of farmers, "are shod with silver"—for, wherever the sheep sets its foot, it does good.—It is of course the wool which proves so valuable as a money-making product, when prices are good—and perhaps we shall be pardoned for adding some brief details, of a technical nature, as to what may be done with a pound of wool.

"It is estimated that one pound of wool will yield in fine

* See Silver's *Graziers' Guide for Cattle in Australia*, p. 17, etc.

† *Statesman's Year Book for 1896*; edited by J. Scott Keltie. (Extracts from returns, totals added together).

§ *Ibid.*, p. 273.

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yarn 84,000 yards, or (nearly) 47⅞ miles:—a pound of combed wool has however been spun into a thread of 168,000 yards, or nearly 95½ miles; and the same weight of cotton into 203,000 yards, or over 115½ miles." *

The great sheep-farming colony of Australia is New South Wales, whose flocks number nearly 57 millions —Queensland follows next with over 19 millions—Victoria has a little over 13 millions—South Australia a little over 7 millions, and West Australia above 2 millions—making a total just over 99 millions of sheep. †

The British possessions in South Africa also, mainly consist of a pastoral country—sheep do particularly well, and in 1891 £2,619,924 worth of wool and hair were exported from Cape Colony; together with nearly half a million worth of skins and hides, and £468,221 worth of ostrich feathers, besides further quantities from the Colony of Natal, not included in these returns. §

New Zealand has also a most promising future before it, as a pastoral country; and really we do not know where we have ever seen a finer lot of sheep, than we have met with in this flourishing colony.—After visiting some of the great meat preserving establishments however, we regret to have to chronicle a serious depression in this industry, which however we trust is only of a temporary nature. The more rainy nature of the climate confers upon New Zealand an immense advantage over Australia as a pastoral and

* *Engineer* of May 17, 1889.

† Extracted from *Statesman's Year-book for 1896;* edited by J. Scott Keltie (from returns of the different Australian colonies).

§ See Brown's *South Africa*, published in Cape Town, 1893, pp. 46 and 48.

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stock raising country, and we have every reason to hope that New Zealand will in due course reap the golden harvests which a beneficent nature seems to have destined to be produced there: not only in quantity and quality, but also in remunerative financial returns.

These results, we feel confident, will D.V., unquestionably accrue to all our great colonies of the southern hemisphere, as time and progress move on together.

We have already alluded to the fact that during the dry season many of the waters throughout "The Region of the Great Plains" are apt to become saline. This peculiarity is of course confined to certain districts, but in almost every part of the world, within this zone, it would be possible to cite notable instances of it. In Algeria for instance, the salt water lagoons are termed "Shotts," and in the French guide book it is stated that in the three provinces, "it is reckoned that there are 26 large saline lakes, 21 saline rivers, and 7 deposits of rock salt." * In many parts of Egypt even wells sunk in the valley of the Nile, not far from the river, produce brackish, and even salt water. Then in South Africa, Australia, North and South America, Siberia, etc., these saline waters are found extending over large areas of country.

In these places after heavy and continuous rains, when the rivers and lakes are filled to overflowing, of course the water will very likely be found fresh, but after the dry weather has set in, when they begin to fall rapidly, it gradually becomes brackish, and finally, should there be a long dry season, often so highly saline as to be quite undrinkable; and sometimes

* See introduction to *Algérie et Tunisie*, par Louis Piesse, 1891, p. xlviii.

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in such localities square miles of country may be seen whitened by an incrustation of salt, as if by a fall of snow. Even in their brackish state, these waters are apt to create diarrhœas, and bowel complaints of various kinds, which are always troublesome, and at times exceedingly injurious to the health of persons obliged to drink them.

The late Mr. Charles Darwin has given an interesting account of his visit to one of these salt districts, near the Rio Negro, which forms the north eastern boundary of Patagonia, and mentions the existence of salt lakes near El Carmen, at the mouth of that river; where in summer time, when their beds were dry, a floor of salt was exposed, two or three feet thick, remarkable for its purity.—The export of this salt in fact formed the main staple of trade from that river. * He also mentions, that at the time of the disastrous droughts which took place in the provinces of Buenos Ayres and Santa Fe, between the years 1827 and 1830, known among the gauchos as "El gran Seco,"—"all the small rivers became highly saline, and this caused the deaths of vast numbers of horses, cattle, etc., in particular spots; for when an animal drinks of such water" (he tells us) "it does not recover." The loss of stock indeed, in the province of Buenos Ayres alone, was reckoned at "a million head": one unfortunate proprietor at San Pedro, we are told, "had previously to these years, 20,000 head, and at the end not one remained." †

* See *Journal of Researches on Natural History and Geology during the Voyage of H.M.S. Beagle*, by Chas. Darwin, edition of 1878, pp. 65—6.

† *Ibid.*, pp. 133—4.

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It will thus be seen that the existence of brackish waters in a district may at any time become a matter of serious moment, in case of any prolonged drought setting in.

Why the waters should turn salt in this way is a question more easily asked than answered; but we may be sure that it depends, like everything in Nature, upon some plain and constant rule, could we only discover it; and if we might venture to hazard an opinion upon a matter concerning which there are so few data to go upon, we should say that the collection of salt is caused by imperfect drainage.

In these very flat countries the rivers and streams have no proper watershed to convey the waters to the sea. The consequence is, heavy rains are certain to cause disastrous floods; as the inundations subside, the floods of course retire to the lowest levels: this accounts for the formation of the extensive shallow lagoons, and marshes, which are generally characteristic of these countries; but as the water always holds in solution a certain proportion of earthy salts, these are in consequence carried down to, and collected at these spots; and are of course precipitated there, when the water dries up; and by the constant repetition of this process, year by year, for vast periods of geological time, these lagoons and lowlands are at length turned into salt marshes, and sometimes even into deposits of pure salt.

This theory seems to be the more probable, inasmuch as we know that large bodies of water, which have no outlet to the sea, are always salt—of these we may cite the Caspian Sea, and especially the Dead Sea, as prominent examples.—It is probable that the saltness of the ocean itself is due to similar causes,

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operating throughout the course of countless ages.

The turning of freshwater rivers and streams, during periods of drought, into salt water, is a matter, explained, as we conceive, upon the same principles. All these streams run through extensive flat plains, upon which the floods have already deposited a considerable seasoning of salt—the course of the stream naturally marks the area of lowest level. Then, as long as there is plenty of water, the solution of salts is too weak to attract particular attention: but after a long drought, when the waters become greatly reduced, the solution becomes so strongly concentrated by evaporation, that the remaining water may be as salt as the sea, or even salter—and thus the most disastrous consequences, both to men and animals, have been frequently brought about.

The sufferings from thirst during "El gran Seco" to which we have already alluded are, even now, terrible to contemplate.

So little rain fell, Mr. Darwin assures us, that the vegetation was entirely destroyed "and the whole country assumed the appearance of a dusty high road. Very great numbers of birds and wild animals," in addition to the domestic stock, "perished for want of food and water." So great was their distress that, Mr. Darwin says, a man told him "that the deer used to come into his courtyard, to the well which he had been obliged to dig to supply his own family with water, and that the partridges had hardly strength to fly away when pursued." Even on the banks of the great river Parana terrible scenes were witnessed, "the cattle, in herds of thousands" in an agony of thirst, rushing down into the river, "and exhausted by hunger,

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were unable to crawl up the muddy banks, and thus were drowned. The arm of the river that runs by San Pedro was so full of putrid carcases, that the master of a vessel" assured Mr. Darwin, "that the smell rendered it quite impassable," and Mr. Darwin says that "without doubt, several hundred thousands of animals thus perished in the river." *

Azara, a Spanish traveller, describes "the fury of the wild horses, on a similar occasion, rushing into the marshes, those which arrived first being overwhelmed and crushed by those which followed"—and Azara asserts "that he had more than once seen the carcases of upwards of a thousand wild horses thus destroyed" (Azara's travels, Vol. i. p. 374). So also in a great drought in India, Dr. Malcolmson informed Mr. Darwin "that the wild animals used to enter the tents of some troops at Ellore" in search of food and water, and wonderful to relate, even a timid "hare drank out of a vessel held by the adjutant of the regiment." †

The rivers and streams which cross wide level plains are often so peculiar in their character, that their geographical features call for special attention from all travellers.

It might be supposed that through so flat a country there would be very little current; the contrary however, is, as a rule, the fact: thus affording conclusive proof of how completely the eye is deceived. We have already alluded to the fact that upon the great pampas region of South America, it had struck us

* *Journal of Researches into the Natural History and Geology of the Countries visited during the Voyage of H.M.S. Beagle round the World*, by Charles Darwin, edit. of 1878, p. 134.

† *Ibid.*, footnote to p. 134.

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that if possible, larger stretches of apparently dead level country were more common than anywhere else; and Mr. Darwin seems to have been impressed with the same opinion, for he mentions that—

"For many leagues round San Nicholas and Rosario, the country is really level. Scarcely anything that travellers have written about its extreme flatness can be considered as exaggeration; yet I never could find a spot where, by slowly turning round, objects were not seen at a greater distance, in some directions than others; and this manifestly proves the inequality of the plain. At sea, a person's eye, being six feet above the surface of the water, his horizon is 2¼ miles distant. In like manner, the more level the plain, the more nearly does the horizon approach within these narrow limits; and this in my opinion, entirely destroys that grandeur, which one would have imagined that a vast level plain would have possessed." *

There can be no doubt that if the plains were actually level, this would be so; but this, as Mr. Darwin explains, is not so; and with all due deference to so eminent a scientific authority, we venture to state that our own experience teaches us that throughout all these regions there are here and there to be found positions from whence magnificent panoramas may occasionally be obtained; a conception of whose spacious, almost immeasurable grandeur is not easily conveyed in words; and we think we are supported in this by most of the books of travel descriptive of the plains region. That a long march of many days across vast open plains is often oppressive, on account of its monotony, is however generally admitted; but even in the flattest plains, extensive views are now and then to be had: the traveller is then of course

* *Journal of Researches*, etc., by Charles Darwin, p. 127.

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crossing the crest of an eminence, whose slope may be so gradual as to be entirely imperceptible—but it is nevertheless sufficient to create a rapid currentin a stream.

In vast plains regions, like that of the American prairies and the pampas, bounded towards the west by a giant chain of mountains, and to the east either by a great river, such as the Mississippi, and its continuation the Missouri, or by the ocean: there are generally two sets of water-courses—one of these consists of streams proceeding from some central ridge in the continent, which make their way either to the great river or to the sea; whilst the other, mostly consisting of mountain torrents, in many instances become lost in the plains. It may be that these latter merely grow smaller and smaller, until at length they disappear altogether; or else, they end in salt lakes or marshes, such as we have already described. This of course is more particularly the case towards the warmer and drier limits of the Region of the Great Plains, which adjoin the Desert Zone, and nearly all plains countries and extensive elevated table lands furnish numerous examples of such streams. In Europe we may refer to the case of the Guadarama River, in Spain, which is lost in the plains and marshes of Murcia—a locality visited by few travellers, but which, we can say from personal observation, is quite worth a visit, as a matter of geographical interest. In South America we have also seen great numbers of similar cases.

As a rule, along the banks, and in the meadows subject to floods, which lie along the margins of the rivers and larger streams, more or less timber is to be found; heavy timber is however rare, and in most cases it consists either of medium-sized deciduous trees,

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or else of bush. The courses of rivers indeed may very generally be seen mapped out, in the distance, by this fringe of timber; which thus acts as a guide, to direct the traveller to a camping ground, where those three great essentials, grass, wood, and water, are to be found. At the end of a long march therefore, when evening is drawing on, or when the sky indicates the approach of storms, the appearance of these trees upon the horizon often forms a welcome apparition to prairie travellers. In the icy winds too, which periodically sweep over these plains, a ravine, or other cosy nook, among these sheltering groves, must at once be sought for; and the prudent traveller will do well to mark, as he goes along, and keep in his mind's eye, the location of such spots, to which in case of need he may be able to fall back. *

The shores of the larger lakes are, in the same way, usually found bordered by woods and bush. On the other hand, when the strand at the edge of these sheets of water is seen perfectly clean, like the sea shore, and the banks clear of timber, it very often (though not always) indicates that the water is salt. The presence too of flamingoes, is an almost certain sign of saline waters, or marshes, which form the constant haunt of these curious birds; which are supposed to feed on particular sorts of worms, and other insects, which live in vast numbers in the mud of even the saltest lagoons. †

* This practice of noting eligible spots for various purposes is one which soon becomes second nature to leaders of parties travelling through wild countries. In hostile neighbourhoods for instance defensible posts and positions to which it may be possible to fall back in case of need should invariably or studied and made careful note of.

† *Journal of Researches* etc., by Charles Darwin, edition of 1878, p. 67.

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These belts of timber, wherever they occur, also form the resort of game of every description which the country affords; and, as the reader will find more particularly described in the sections on hunting and shooting, a stroll, up the wind, in the vicinity of these lakes or streams, will frequently procure the chance of getting shots at deer, or other animals. The waters themselves are, besides, often found covered with different kinds of wild fowl, which probably more than any other class of game afford palatable and useful additions to the larder; generally easily got at, and procurable in most places in numbers sufficient to supply the wants of small parties of travellers. The presence of these birds also indicates that of fish, and in most of the lakes and streams the angler may obtain good, and in many cases magnificent sport, as a reference to our section on fishing will, we trust, conclusively show.

Now as regards the crossing of these streams, which is of course a thing of almost every-day occurrence, while travellers are on the march this is a matter which requires to be specially considered:—Each different class of country is drained, as a rule, by its peculiar type of stream. The best means of procedure will therefore depend upon the character of the banks and stream beds, which vary according to locality in a variety of different ways too numerous to mention here. We shall therefore only describe one or two of the most remarkable types of such plains rivers.

A very common type of prairie stream is one where the current, upon ordinary occasions, flows in a comparatively narrow channel through a wide expanse of sand and gravel, testifying to the mighty force with

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which the water has torn its way through the plain, during the freshets to which all these streams are liable. As long as the bottom is hard and even, of course, the passage of these streams presents no special difficulty at low water. At other times, where the sand is fine, the current during a flood often scoops out deep, though narrow channels, whose sides go down suddenly, like a wall. If the stream is turbid, it is very hard at times to detect these places; so that a man on horseback may enter the swift-flowing river, where the water appears only a few inches deep; and all at once the bottom seems to give way, and the horse falls, as it were, into a hole, where swimming at once becomes necessary, and where getting out again is at times by no means an easy matter; for the horse breasts the opposite bank, which is frequently perpendicular also; and should he succeed in getting his forefeet upon the top, the edge, which is generally running sand, at once gives way.

In some districts of country these places are rendered specially dangerous from the enormous quantity of this impalpable sand with which the current is surcharged when the stream is in flood. This sand is sometimes carried down by the water in such quantities that the current in such places seems to consist rather of waves of moving sand, than of water. When this is so, the weight of the stream is so enormous, that it is apt to bear down and engulph in an instant, everything that opposes it. Numerous fatal accidents have occurred through unwary travellers incautiously entering these sand streams, where horses and men have frequently been known to disappear for ever in the twinkling of an eye.

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Thus, Colonel Dodge, gives an account of an accident of this kind, by which two of his soldiers lost their lives. It seems they were fishing with a seine-net in the South Platte river, at a place where the water was apparently only two or three feet deep; when suddenly three of the men furthest out from the bank went down. "One of them," the Colonel tells us, "was caught by a comrade and saved; but the others were never seen again, in life or in death. The sand never gives up its dead." Moreover, as Colonel Dodge explains, "a man caught in these moving sand waves seems to lose even the power of struggling." * The destruction of wild animals in the same way, while attempting to cross these streams, has often been very great. Indeed, "as late as 1867, 2000 buffalo perished in the quicksands of the Platte river," as we were told on the authority of the well-known zoologist Mr. W. B. Tegetmeier, in a recent article "On the Extermination of the Bison." † These catastrophes to buffalo were common in former days; and Sir George Simpson, Governor of the Hudson Bay Company, as well as other well-known travellers, have left accounts of cases where enormous numbers of these animals, sometimes amounting to many thousands, perished in this way, either by getting caught in quicksands, or mired under such circumstances that escape was impossible. As we know, animals frequently get mired in boggy places, even on English farms, notwithstanding the care that is taken to drain, or fence off, unsafe spots, and would perish but for man's assistance; but

* *The Hunting Grounds of the Great West*, by Colonel Richard J. Dodge, U.S.A., 1877, p. 25.

† See this article in *Illustrated London News* of June 11, 1892.

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in wild countries, deep and dangerous sloughs are very common, and heavy losses among herds of game animals, which follow their leaders like sheep, are in consequence matters of every-day occurrence, as the frequent discoveries of the bones of extinct quadrupeds, sometimes in large numbers found in such situations, even in our own land, conclusively show. We have seen a place, for instance, in an Irish lake, where a whole herd of what we believe to be the now extinct red deer of Ireland, had evidently thus perished in ancient times, leaving their heads and horns, etc., all within a small area, as a memento of the fatality.

The margins and beds of some of the prairie streams also occasionally consist of regular quicksands, though these are fortunately of comparatively rare occurrence. When they do occur however, quicksands usually consist of the finest impalpable sand, almost like mud, and yet still distinctly sand: but of so fine a nature, that it runs together under the action of water, almost like quicksilver.

It is probable that man, with his light weight and comparatively large feet, except through extreme want of care and caution, but rarely falls a victim to these treacherous sands; though as we have shown, large numbers of the heavier quadrupeds frequently do meet their end by being caught in them. Indeed there are probably few experienced plainsmen who have not at one time or another had serious trouble, and perhaps loss, by some of their stock getting foundered in such places.

A human being, horse, or ox, once embedded in a quicksand, is almost certainly doomed to a terrible death, unless speedy relief is at hand; for in a really

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deep and bad quicksand the tendency almost always is for the unfortunate captive to gradually sink deeper and deeper, until suffocated; and the body perhaps entirely covered by the sand—or at any rate he is held prisoner, like a rat in a trap, until he dies of exhaustion.

The tenacity of the sand in some of these places is something that must be seen to be credited; indeed if it once gets a fair hold, escape becomes a moral impossibility, for the sand closes in upon the captive, and holds him like a vice, his struggles only causing him to sink in it more and more.

Should a horse for instance get caught in one of these quicksands, trying to dig it out is rarely successful, for the sand runs in at least as quickly as it is thrown out; the best and perhaps the only chance of extricating him is to try and get poles, or whatever may be at hand, passed underneath him, so as to prevent his sinking deeper, and above all promptly to fasten a strong rope round the body or neck, to the other end of which two or more horses are hitched, and thus haul him out by main force.

In these cases men can fortunately generally walk around the unfortunate animal, without incurring any serious risk—provided they keep constantly shifting their feet—as the surface even of the most dangerous quicksands is often comparatively firm. The following instructive and terrible story will however show what a quicksand *may* sometimes be found capable of doing. The circumstances, we admit, are but little likely to befall travellers crossing prairie streams; yet from the extraordinary and we trust almost unexampled details, we think the story quite worthy of recital here.—In the spring of 1890 a Mr. James H. Parsells was

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building a well about fifteen feet deep, sunk down to a quicksand, at Woodside, New York, when the sides caved in, partly burying him. When discovered, his head and part of his body, were however still above the sand. Abundant assistance was at hand, and—

"His two sons worked desperately to save their father's life, and dozens of men worked with shovels round the well, whilst others fastened ropes under Mr. Parsell's arms. Ten men pulled on the rope, from the second story of the house, until deep ridges were made by the rope in the window sill; but all efforts failed—and the agony produced by the tremendous strain was so great, that at the request of the doomed man himself the attempt was given up. Meanwhile the sand constantly packed itself more solidly round him, and continued to rise up over his head and shoulders. A rubber tube was placed in his mouth to supply him with air, while the rescuing party fought the deadly sands desperately; but they could not dislodge the body from their tenacious grip. John, the elder son, stood at his father's side, and with a shovel worked furiously for nearly two hours. Three times he succeeded in clearing away the sands from his father's head, but they rapidly rose up again like the waters of a spring, and at last covered him entirely. After a long time they succeeded in getting the body out—but life was extinct."*

This terrible incident shows the extraordinary tenacity with which quicksands will sometimes hold their victim; and the difficulty of effecting a rescue, even when abundant means are at hand; and we think it more than justifies any observations or words of warning which we have written on this subject: a matter which we believe no other traveller has done more than casually allude to.

* Condensed details from Report in the *Scientific American Newspaper* of June 14, 1890.

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The more ordinary cases of waggons and animals becoming mired in sloughs and other swampy places, we are hardly concerned with at present, though these accidents are very common in all wild countries. In the prairie region however, these spots are known under the name of *couleés*, and consist very frequently of blind watercourses, over-grown with reeds, and other aquatic vegetation, situated at the bottom of depressions, worn by the water to some depth below the surface of the plain, which sometimes form very troublesome obstacles.

Extensive swamps are also occasionally met with, quite impassable for animals and vehicles, apparently consisting of chains of blind lakes, or lagoons, whose waters have in like manner become grown over with a thick mat of vegetation, which if once broken through, may be found to cover a mass of soft mud and water, of it is impossible to say what depth—but passes are sometimes found between these lakes, by which caravans may cross, at spots where there are fords, with a hard bottom.

A still more curious class of country, and one which is full of difficulties for the wayfarer, is that where the surface of the plain is scored in all directions with numerous ravines. These may be of almost any depth, and are generally cut in the shape of the letter "V", and though some are dry, generally there is a stream flowing at the bottom, which after heavy rains becomes a torrent. Some of these ravines are occasionally of enormous dimensions and depth, descending abruptly for perhaps one or two hundred feet or more below the general level of the plain; and in the absence of roads, should the banks be very precipitous, they pre-

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sent impassable obstacles. * Also, in a country where there is any fear of malaria, ample experience has shown that these ravines act as a species of conduit pipe, up which malaria is certain to travel; and that there is no surer way of getting a smart attack of intermittent fever than for travellers to encamp in one of these situations.

Natives, if left to themselves, are apt to select such places as these for camping, because of their vicinity to water, and because of the shelter which they afford from the bitter night winds, which so often sweep over the high plains above. The frequent occurrence of dwarf trees and brushwood, so generally found growing on the steep banks of these gorges, which afford a plentiful supply of firewood, is of course a further source of attraction.

These ravines almost always run up from the valleys of the different plains rivers, until they reach the centre of the table land which divides one watershed from another—gradually becoming smaller and shallower, until at length they run out to nothing in the surface of the plain at the point indicated, which for this reason is known among plainsmen as the "divide." The importance of these divides to travellers crossing the high plains can hardly be overestimated; because from possessing a generally fairly level surface, they furnish a pass practicable for wheeled traffic, through

* A typical instance of a "Ravine Country" occurs in India, between Ráwal-Pindi' and Jhelum, where a complete labyrinth of these channels, all with precipitous banks of a deep-red colour, and varying from twenty to fifty, or even sixty feet in depth, extend along the line of the N.W. Railway for some forty miles.

Another smaller, but somewhat similar country is to be seen a little to the northward of Gwalior, on the section of the Midland Railway between Agra and Gwalior.

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a country which would otherwise be totally impassable.

An experienced plainsman however, by following the line of the divide is able to avoid the ravines; and though the route may often be of necessity a very circuitous one, still in the end he can generally succeed in conducting a train of waggons, or pack animals, by this means, from one point to another, without meeting any very serious obstruction.

The faculty of being able to distinguish the true "divide" from false ones: that is to say, from those that lead into a *cul de sac*, has always been esteemed one of the best tests of a plainsman's abilities; and like the gift of following a blind trail, or any other accomplishment, the art may be learned or at any rate the instinct be largely developed by experience—and a clever guide can generally tell by observing the lie of the country, and especially by noting the direction of the game paths, which of the many headlands he ought to follow.

Buffalo, and probably most other kinds of heavy game,* generally travel along the divides during their migrations, and so save themselves the labour of repeatedly crossing deep and precipitous ravines; many of whose banks are besides covered with dense thickets of brushwood, a thing always avoided, if possible, by many kinds of plains animals, such as antelopes and other timid creatures, who rely upon their speed and quickness of vision for protection: instinct therefore teaches these animals to shun the neighbourhood of cover, on account of the concealment it affords to

* The ancient elephant paths in Ceylon and Southern India furnish another excellent example of the same kind: these great natural game paths will remain visible in the jungles for ages after the last elephant has left its trail there.

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beasts of prey and other enemies. The consequence is that divides are very often marked out by a well-defined game path, and we have the authority of Colonel Dodge for stating, as regards the American bison (*Bos Americanus*), that where a regular beaten path of these animals exists, it almost invariably, in such situations, follows the divide, and that "nine times out of ten waggons can follow, wherever a well-marked buffalo trail may lead." The Colonel also relates an excellent instance of the way in which an Indian guide led a waggon train by means of the divides, through an otherwise almost impassable country.

"I received my best lesson," (he says) "on plains craft, from a Pawnee Indian, who took a party under my command, with waggons, without delay or the slightest accident, over a section of 'Bad Lands,' which after examination I believed utterly impassable. The 'divide' followed was extremely narrow and tortuous; in one place so very narrow as to require skilful driving for the passage of the waggons; the ravines on each side being generally perpendicular banks, from thirty to eighty feet deep." *

Some useful diagrams are given in Colonel Dodge's book, showing the winding course generally followed by "divides," and how it is possible, by following their meanderings, to pass through a country, avoiding both ravines and stream beds—a matter which it is not easy to explain in words.

The bed of a river however may be taken to represent the exact opposite of the "divide"—and the level lands along its edges are known as "bottoms." The

* *The Hunting Grounds of the Great West*, by Colonel Richard J. Dodge, U.S.A., 1877, p. 56.

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river follows the lowlands, as the divide does the headlands, yet the river in most cases, by simply winding and turning among the hills, at length finds its way down to the sea, without the necessity of cutting through any considerable gorge, under ordinary circumstances, throughout its whole course. The river channels therefore furnish another route by following which the hills may be avoided; river valleys are therefore, as we know, often used by railway engineers for this purpose—but it is not generally a good line for travellers to follow through a wild country of a rugged and hilly character, unless there is a dry river bed of sand or gravel, forming a natural road, because the ground alongside of river beds is very often exceedingly broken and obstructed by trees, bushes, swamps, ravines, and other obstacles; and if the river is bordered by cliffs, the stream, by its constant windings from the base of one cliff to the other, renders progress impossible, except at the expense of innumerable crossings, which are almost always dangerous in such places, and often quite impracticable. There is, besides, the risk of sudden floods which, as we shall presently show, may at any moment cause the utter destruction of the wayfarer, overtaken during his passage through these defiles, from which a speedy escape is often impossible.

Many of these defiles along the courses of great rivers however are grand and impressive beyond description, and frequently present the finest natural scenery in the country.

But the most wonderful of all these water-channels are the Cañons that traverse the highlands of Colorado, and other parts of the south western territories of the United States, which must certainly be ranked among

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the greatest wonders of the world. The word Cañon (pronounced 'Canyon' in Spanish) besides a gun-barrel, is used to denote any narrow passage, such as these deep gorges *—which are many of them cut through solid rock; their walls sometimes descending, almost vertically, for even thousands of feet below the surface of the plain; while at the bottom a foaming torrent usually dashes along the rocky bed which, constantly flowing from age to age, has gradually eaten away the living rock, until in the course of time these marvellous channels have been excavated.

The human atom, crawling cautiously along the upper edge, and gazing into the giddy depths beneath, may often see the river flowing, like a silver thread, far down in the stupendous abyss—and it is quite possible that the traveller passing along the surface of the plain above may be actually perishing from thirst in sight of the swift flowing waters:—indeed there can be little doubt that such cases have frequently occurred.

But ere we proceed with our narrative, let us consider for a moment the lesson which these scenes of savage grandeur should convey to the mind of the thoughtful traveller.

Every observer is aware that the tooth of running water is sharp, and cuts deeply,—and yet what a picture of the enormous antiquity of the earth do these Cañons reveal to us. Think of the uncounted ages it must have taken one of these rushing torrents to excavate a single example of these wonderful cañons! and what a marvellous illustration it affords of the tremendous power possessed by running

* See Neuman and Baretti's *Spanish Dictionary*. The word is however of Colonial and not of Castilian origin when used in this sense.

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water for gradually cutting through even the hardest rock. (This is termed the process of 'Erosion'). The enormous volume of material alone that must have been removed by the tireless labourer, during the formation of one of these cañons, is in itself a subject full of wonder and instruction; as showing what may be effected by apparently small resources, ceaselessly working towards the attainment of a particular purpose. Some of these cañons for instance, as we shall proceed to show, extend uninterruptedly for hundreds of miles through mighty rock-hewn gorges, compared to which the greatest monuments of human skill and labour fade into absolute insignificance—indeed it would be difficult to find a more striking instance of the littleness of man, when contrasted with the works of Nature, than that which is here exhibited.

Thus the Grand Cañon of the Colorado, which is only one among many in that district—

" alone extends for a distance of about two hundred miles westward of its junction with the 'Colorado Chiquito'" (or lesser Colorado) "and its walls rise almost sheer from the water's edge to a height of from 4000 to as much as 7000 feet; while further down is 'The Black Cañon,' which, with a length of twenty-five miles, and a height of 1000 or 1500 feet, would be considered a magnificent phenomenon, were it not thrown into complete insignificance by its more stupendous neighbour." *

This wonderful river and its tributaries traverse the great watershed to the westward of the Rocky Mountains throughout its whole extent, and finally force their way down to the sea, at the head of the Gulf of California, most of the way through a succession of cañons,

* *Encyclop. Brit.*, 9th edition, Vol. vi, p. 163.

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which with those of several of its confluents, render the Colorado River system undoubtedly the most wonderful of any in the world.

Another good example of the rock-cutting capabilities of water is to be found in the Grand Cañon of the Arkansas, in Southern Colorado, which is seen from the train, on the Denver and Rio Grande Railway, near Cañon City—"where the Arkansas cuts its way for eight miles through mountain walls of solid granite, in some places 3000 feet high, amid scenery of inconceivable majesty and sublimity." *

Then again, the Grand Cañon of the Yellowstone in the National Park (Wyoming), furnishes another, and if possible still more wonderful instance of a similar kind. Here the river, after plunging over a precipice nearly 400 feet high, "flows for a distance of some twenty miles through a cañon, 200 to 300 yards wide, between perpendicular walls 1200 to 1500 feet deep." Professor Hayden, in his report to Congress on the Yellowstone region, in describing this wonderful natural phenomenon, states that—"no language can do justice to the wonderful grandeur and beauty of the cañon below the lower falls: the very nearly vertical walls sloping down to the water's edge on either side, so that from the summit the river appears like a silver thread foaming over its rocky bottom. †

Volumes might be, and indeed have been written upon the marvels of the cañon country, which until quite recently had never been explored by civilized man,

* Appleton's *Guide Book to the United States and Canada*, 1882, p. 390.

† *Ibid.* p. 411.

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but lay wrapped in the mystery of the unknown wilderness, which it was as much as a man's life was worth to attempt to penetrate; for it lay in the heart of one of the most dangerous Indian countries upon the American continent; indeed the only guides who knew anything of the intricate geography of this region were the Indians or half-breeds belonging to some of the wild tribes whose fastnesses lay in these lonely wastes. They alone knew of the places where it was possible to effect a crossing, which at the best of times was generally a work of both difficulty and danger; for we need hardly say that, except at a few widely separated points, it was impossible for anything but a bird to pass. Travelling through such a country therefore presented almost insuperable difficulties for strangers, who may have had to wander for immense distances along the dry and barren table lands which skirt the borders of these mighty chasms, before a practicable pass could be found, or even before they could reach water.

For instance, in the report upon the United States Government surveys of the great cañon country of Colorado, up to May 1874, Professor Powell states that—"between 'Gunisson's Crossing' on Green River, and the foot of the Grand Cañon of the Colorado, a distance of 587½ miles, it was not known that the river could be reached at more than two points; and these were so near together that only one of them could be used as a deposit for supplies." * Both these places, it seems however, were ancient passes, used by the

* *Report to the United States House of Representatives on the Survey of the Colorado River of the West*, May 1874, by Professor J. W. Powell (Smithsonian Institute, Washington), p. 4.

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Indians from times immemorial; and the writings of one of the early Jesuit missionaries show that it was there that he had crossed when travelling through this country under the guidance of the savages, a century before, and the place is still called "El Vado de los Padres," *i.e.*, "the Priests' Ford," to this day.

Paths, until quite recently known only to the Indians, have long existed, where at certain points a narrow track descends the cliffs, and a similar one ascends at the opposite side, by which these crafty and adventurous savages used to effect a crossing, and so baffle pursuit, when followed by troops, etc.

Advantage was no doubt taken of places where falls have occurred in the cliffs, forming banks of debris, sloping down at a steep angle to the water's edge; and here sufficient beach occasionally exists at the bottom by which people can make their way along the bed of the cañon, until a similar point of vantage can be reached by which to ascend on the opposite side. There are also many dry cañons, without any water at the bottom, which in the dry season, can be used as passages by the Indians, and are practicable as such, throughout their entire length. The U.S. Government explorations and surveys, according to Professor Powell, show that such places are sufficiently numerous, and many of them consisted of—"profound chasms, that are hundreds of feet deep, and that never have a continuous stream for their entire length." * The reports of the few travellers who have published an account of their adventures in the cañon country

* *Report to the United States House of Representatives on the Survey of the Colorado River of the West*, of May 1874, by Professor J. W. Powell, p. 7.

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also inform us that the light of the sun is frequently unable to penetrate into the depths of these gloomy defiles, where a constant twilight prevails, even when the sun is shining brightly overhead; the sky itself at such places appearing as a blue thread of light, seen in the altitudes above.

Professor Hayden, for instance, in his splendidly illustrated folio of the scenery of the Yellowstone National Park, has supplied us with a reliable account of his descent into the Grand Cañon of the Yellowstone, and says it took him an hour and a quarter to get to the bottom, and he found that the river below consisted of—

"a succession of rapids, which dash madly against the rocky walls. The sense of danger" (he tells us) "is truly harrowing, and the awful silence broken only by the sound of the waves."—"The walls in many places," he goes on to say, "slope vertically to the water's edge, leaving no beach, and in places are eroded into fantastic shapes of towers, spires, and gothic columns; in others they present fortress-like fronts, or long slides of brilliantly coloured debris, or massive rock, separated by jointage, resembling irregular masonry going to decay——" while at the bottom "the rocks threw a dark grey shadow all round us. The sunlight does not reach us, but gilds the trees above with its rays. The scene is fearfully grand and surpasses description. The ascent takes two hours; we have to crawl on our hands and knees part of the way, and creep round ledges, knowing that a single misstep will precipate us to the bottom. *

The most extraordinary accounts have from time to to time been published, of the adventures which have

* *The Yellowstone National Park and the Mountain Regions of Portions of Idaho, Nevada, Colorado, and Utah*, described by Professor F. V. Hayden, Boston 1876, p. 45.

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befallen some of the white hunters and trappers who have attempted to explore the great cañon country of North America, which according to Professor Hayden is a region "above 200 miles in length, and 150 miles in width, the whole of which may be said to be almost inaccessible; as in attempting to traverse it, one would be obliged to cross gorge after gorge, with nearly vertical walls, 3000 feet or more in depth." *

Some of these daring adventurers, despairing of ever finding their way out again, or being hunted by Indians, have in some cases been known to float down the current through the cañons, upon logs or rafts, and after encountering numberless perils this has occasionally been safely accomplished. We quote one such case, on the authority of Mr. Bowles, editor of *The Springfield* (Mass.) *Republican*, where a man named White, about 1868, seems to have passed through the Grand Cañon of the Colorado in this way, and lived to tell the tale. It seems that he was prospecting for gold with a companion in Southern Colorado, when being hunted by Indians, they made a raft and committed themselves to the waters at a point in Grand River just before its junction with the Green. While shooting the rapids and whirlpools the second man, and the whole of the provisions, were swept off by the tumultuous waters; but White, the surviving hero, after a passage of fourteen days, seven of them without food, upon these strange waters, furiously rushing between frowning walls of rock, at length reached Collville, in Arizona. "His entire journey on the river," we are told, "must have exceeded 500 miles, and he

* *The Yellowstone National Park and the Mountain Regions of Portions of Idaho, Nevada, Colorado and Utah*, described by Professor F. V. Hayden, Boston, 1876, p. 45.

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represents that for most of the distance it was through these high walls, impassable as a fortress, a dungeon over a cataract." *

The risks incurred in traversing these places even in their dry state, when there is no water at the bottom, are however still very great on account of the liability to sudden floods, which when they occur sweep everything before them with irresistible violence; it will be sufficient to quote a single instance of this kind, which will convince the reader that this danger is neither imaginary nor exaggerated.

It occurred about 1868 in the Apache country in Arizona, and we give the story on the authority of Mr. J. Ross Brown, an American gentleman, who states that—

"A very singular and tragical occurrence took place about two months previously to my visit. Some time in the month of July two men with their wives and three children started from Aurora in a waggon for Big Meadows. The distance is twenty-eight miles; when they were about half way, and were passing through a rocky cañon, unsuspicious of danger, they observed some signs of rain; but thought it was nothing more than a casual shower. Suddenly the sky darkened, and they heard a loud roaring noise behind them. The men, finding the horses unmanageable from fright, jumped out, and scarcely had they touched the ground when they saw a solid wall of water, about six or eight feet high, like a prodigious wave breaking upon a beach in a storm. Before anything could be done the torrent burst upon them, and the waggon was instantly capsized and dashed to pieces on the rocks. In less than a minute nothing was left to mark the tragedy: women, children, waggon, and horses, all had disappeared.

* *A Summer Vacation in Colorado*, by Samuel Bowles, 1869, pp. 84 and 85.

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One of the men by a supreme effort climbed up the face of the rock and managed to escape by grasping a bush." *

The man, who alone survived to tell the tale, brought the melancholy intelligence to the neighbouring town, and described in affecting terms the last struggles of the unfortunate victims, and their piteous cries for assistance before they were overwhelmed by the raging waters; an engraving representing the scene at this moment is also given in Mr. Ross Brown's book.

This tragical occurrence naturally created great excitement and sympathy among the community at the time, and relief parties were at once sent out by the citizens to try and recover the bodies, or relieve anyone who might still chance to be alive, but it was not till some considerable time afterwards that the bodies were discovered, after the subsidence of the flood, several miles below the spot where the accident occurred, in a condition so battered and mutilated as to be almost unrecognizable.

This anecdote conclusively shows the exceedingly dangerous character of any attempt to make a passage through these cañons, even under the most favourable circumstances; and until regular roads are scarped out in the cliffs, by engineering skill, above the possible reach of floods, similar accidents will always be liable to occur; but in the course of time, when this is effected, the traveller of the future will doubtless be enabled to penetrate, both in safety and comfort, into the gloomy recesses of these great cañons; and gaze at his leisure, with awe-stricken wonder and admiration, upon these mighty examples of Nature's power.

* *Adventures in the Apache Country*, by J. Ross Brown, New York, 1869, pp. 427 and 428.

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Another class of these impassable natural fortresses consists of lines of cliffs, or "bluffs" as they are called in America, which are sometimes found to extend as a gigantic barrier across the plains, through a great extent of country; and these, as examples of the work of The Great Architect of Nature, are if possible even more wonderful than the rock-hewn cañon; because in the latter case there is at least some apparent cause, so plain that even the meanest intellect can understand it, which has evidently been the medium by which these channels have been excavated. But how shall we account for these immense walls of rock, which divide one table land of the plains from another? As there is no immediate apparent cause which can account for their existence, people are apt to pass these lines of frowning battlements without ever giving a thought to the means by which they were formed.—"They were always there," it will be said, and it would be a waste of time to try and fathom the mysteries of the incomprehensible.

The wily Indian, for instance, whose whole life has been passed in the constant endeavour to interpret the signs of the wilderness, will from age to age pass and repass along these grand escarpments, and his trained vision will note every little item, which, though often quite invisible until pointed out to the unpractised eye, yet to his sharpened senses they will afford irrefragable evidence of everything that has happened in the locality for many days before he passed there as plainly as if he had been there to see it.

For neither man nor beast can pass without leaving a mark. Thus, the faintest impression in the sand, a pebble turned over upon its bed, a few blades of grass

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pressed down in a certain direction, will each and all afford unerring proofs of the previous passage of some man or animal--and he will tell you to a nicety, by means which it would be too intricate to attempt to explain here, exactly what it was that made the mark: how long ago, at what speed, and for what purpose, it had passed.

But to him the beetling cliffs above convey no meaning—no lesson. Yet, as Professor Powell is careful to point out—"perhaps the most wonderful of the topographical features of the country are these lines of cliffs, escarpments of rock, separating upper from lower regions, often vertical and impassable barriers, hundreds or thousands of feet high; and scores, or hundreds of miles in length." *

Everything upon the American continent seems to be formed upon so vast a scale that it is not always easy for the average stay-at-home Briton to realize upon a small scale, what these great natural barriers are like; if however we might venture to suggest an example, we would refer the British enquirer to an inspection of the Undercliff in the Isle of Wight—and for two reasons, first because it gives a picture in miniature of the great cliffs of the American plains region, and secondly because the means by which they were created are to some extent apparent.

To what great natural force shall we ascribe them?—Were they upheaved from the bowels of the earth beneath?—or did some great subsidence of the plain below leave them standing aloft as an eternal memorial of some vast terrestial movement of former ages?

* *Report to the United States House of Representatives on the Survey of the Colorado River of the West*, by Professor J. W. Powell, 1874, p. 9.

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The answer to these questions must of course always remain more or less a matter of conjecture. Nevertheless, if we might venture to hazard an opinion, we should decidedly be inclined to ascribe the existence of these cliffs to subsidence. In "The Undercliff," for instance, there are numerous evidences which point to the action of extensive land-slides—some of which are matters of historical record.

We can come to no other conclusion that that the great ranges of bluffs in North America were formed in a precisely similar manner, by an extensive land-slide upon a gigantic scale, possibly consequent upon the softening down of substrata by the infiltration of subterranean waters, or more probably still by the withdrawal of the support afforded by the waters of an ancient sea; of whose former presence the marine shells, etc., found embedded in the stratified rocks, afford, as geologists unanimously admit, indisputable evidence. And as the experience of engineering works shows, the lowering of the waters of a lake or other inland reservoir, by drainage, etc., will almost always produce upon the banks superficial land-slides, which will often exactly represent in miniature the great earth movements of which we have here spoken. In such cases, there can be no doubt as to the exciting cause—the support afforded by the mechanical pressure of the water being gone the bank is no longer able to stand; a fissure forms in its surface, the bank cracks away from its former position, and slips down to a lower level, so far as the force of gravity admits of it—leaving a miniature cliff standing behind it.

These land-slides are however merely one of the

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many instances afforded by the study of natural phenomena which show that the general tendency of Nature is to smooth down excrescences, to gradually lower the level of great mountain ranges, and so efface the evidences of former convulsions. Against this theory there is the supposed gradual upheaval of the coast line, which is thought to have taken place within historic times in some countries—but a simple explanation of this phenomenon would seem to be afforded by a possible slight alteration in the *level* of the ocean which bathes their shores; and the encroachment of the sea at other points, which is probably a consequence of the same movement, would be capable of similar explanation. Among the numerous and complicated motions imparted to the earth by the different natural forces (amounting in all, according to the French astronomer Camille Flammarion, to 14 distinct movements) and the consequent continual and gradual shifting of the terrestrial axis, it is easily conceivable that these slight alterations of the position of the ocean waters might occur. Moreover, the undue accumulation or melting of the Polar ice would of itself be sufficient to affect the general level of the circum-terrestrial sea, to a very appreciable extent.

Leaving however these great questions to one side, which involve abstruse problems of geological science, capable only of a possible solution, after an exhaustive study of the whole position, by competent specialists, we shall merely advert to the fact that all over the world the division of the land into a system of natural terraces seems to be the rule instead of the exception; and a section giving the approximate contour of any great continent is generally found to show a series of

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such table lands, whose boundaries are usually defined by ranges of hills, whose slopes gradually lead up to the next superior plateau. This alteration in the general level of a country is however apt to escape the observation of an unpractised eye, until it is demonstrated on the applotment of a survey; it is only when precisely the same thing occurs by a substitution of a range of gigantic bluffs for slopes, that the fact becomes evident to all, and excites astonishment.

Nevertheless, similar results effected by slopes instead of bluffs may occasionally be seen executed by natural agency, with splendid effect, in South America and elsewhere. The traveller, in this latter case, sees before him what appears to be a range of hills, and after toiling up them until he reaches the top, instead of the crest of a "divide" from which he can look over and down into a valley beyond, he finds that he is on the edge of a wide-spreading level table land, often called "*El Tablazo*" by the Spaniards, which stretches forth, it may be to the distant horizon—or, possibly, in some cases, he may find that it is bounded on the sky-line by the blue silhouettes of mountains, which may mark merely the edge of another, and somewhat similar, though more elevated plateau beyond.

Turning and looking back from a position such as we have here attempted to portray, the traveller will in many cases be rewarded by a magnificent panorama, whose spacious grandeur and sublime combinations of colour and distance convey to the senses, far more even than the ocean, an idea of the infinite, in which the human atom is dwarfed almost to nothing, and becomes of small account indeed.

And now, if we consider for a moment as to how

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the formation of these great natural terraces can be accounted for, we humbly venture to suggest that we see in those slopes the probable results of subsidence, when the land was still in a soft condition, such as that of clay or mud; as distinguished from its probably more or less hardened condition when it cracked away, leaving the lines of towering bluffs upstanding, of which we have already spoken; beyond that we think it would hardly be expedient at present to attempt to carry this question.

There are many examples of these great elevated table-lands in Nature, notably in Peru and Bolivia, in South America, but above all in Thibet, where the average level of the table-land may be taken as about 15,000 feet above sea-level. * This magnificent plateau is bounded by some of the loftiest known peaks in the world, many of them exceeding 20,000 feet in height, while the dimension of the Thibetan mountain area, from east to west, is about 2000 miles, and its average breadth somewhat over 500 miles. †

Let the reader imagine, if he can, the gigantic nature of the forces which have upheaved this immense region to these altitudes—for mountain chains are created by upheavals, as we shall show in due course. Hardly inferior, however, either in extent or in elevation, are the table-lands in the interior of Peru, ranging from 11,000 to 14,000 feet above sea-level, and bordered by the great range of the Cordilleras. The famous saline lake of Titicaca, almost equalling Ontario in extent, is here found embedded in the hills, at a height

* *Encycl. Brit.* Vol. xi, 9th edit., p. 822.
† *Ibid.*, p. 822.

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of 12,196 feet over sea-level *—and we believe that we have the honour of being one of the first travellers who brought photographs of this wonderful lake to Europe.

Though a few stunted bushes are occasionally found in sheltered spots at these great heights, these table-lands, we may add, consist almost invariably of open grassy plains, the cutting nature of the icy winds generally preventing the growth of trees and shrubs.

Time and space will not admit of our considering, except in the briefest possible manner, the herbaceous vegetation which covers the great plains with a carpet of verdure, and adorns their surface with its immense variety of floral beauties: the amazing quantity and luxuriance of the wild flowers being occasionally so great, that in certain sections of country they almost appear to usurp the place of grass, and create what are sometimes known as "flower prairies," by those who know where to find them. Edible bulbs may also frequently be found in considerable quantities: each of the great prairie regions being generally characterized by its own special varieties. The silver-leafed "Prairie Turnip" (*Psoralia Esculenta*) is a good instance in point, and affords a vegetable by no means to be despised by travellers crossing the high and dry plains of North America. § These bulbs are about the size of an egg, and are generally found growing one or two together; they are very common in parts of the Sioux country, where they are eagerly hunted for by the Indians, and the native name for them is *Tipsinah*, in the Sioux tongue.

* Stanford's *Compendium of Geography and Travel for South America*, edited by H. W. Bates, p. 210.

§ See *The Commercial Products of the Vegetable Kingdom*, by P. L. Simmonds, 1854.

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Of grasses of course there are numerous varieties; of these perhaps the far-famed Buffalo Grass (*Sesleria Dactyloides*) is the most remarkable; it covers most of the higher and drier portions of the North American plains with a very thick, dwarf-growing herbage, three or four inches long, of an extremely nutritious character, and eagerly devoured by all the herbivora. Throughout the spring and summer it forms a beautiful sward of emerald green, which later on turns to a colour something like that of fresh hay; indeed its most valuable quality is this peculiarity that it forms excellent natural hay, which preserves throughout the severest winters all its most nutritious qualities. Transplanted to localities where it is not a natural habitant, it is said to have been found to change its character so greatly that it could hardly be recognised as the same plant, and becomes a tall, coarse, rank-growing grass. *

Among other valuable and noteworthy varieties, the tall gramma grass of the Texas plains (*Chrondosium*) may be mentioned. It grows on the prairies there to a height of two or three feet. Then the bunch grass of California (*Elymus Condensatus*), and also the Tussock grass (*Dactylus Cæspitosa*) of the Falkland Islands, afford other conspicuous examples of valuable natural forage plants of various descriptions of plains countries.

In the more settled lands of the State of Kentucky too, where the plains first begin to replace the forest growth, the country is celebrated for its famous pastures of "blue grass" (*Poa Compressa*), said to be the finest grass in America, and perhaps in the world, which is

* *The Hunting Grounds of the Great West*, by Colonel R. J. Dodge, U.S.A., 1877, p. 33.

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possessed of such valuable qualities for grazing purposes that Kentucky is called "The Blue Grass State." * This grass assimilates very closely to the "*Poa Pratensis*" of our own meadows, and is sometimes considered identical with it. †

As a weed we must notice the wonderful case of the variegated leafed Pampas Thistle (*Carduus Giganteus Variegatus*) of South America, which is really in its way one of the marvels of the vegetable world, as in a few weeks it springs up so rapidly as to create prickly and impassable thickets, in which a man on horseback would be lost to view like a needle in a haystack; indeed it would scarcely be an extravagant flight of imagination to conceive the possibility of an army marching out over these lands, and finding their return two or three months later, barred by the growth of these giant thistles (which cover enormous areas in the Banda Oriental and elsewhere §), as effectually as by the bayonets of a superior force drawn up across its line of retreat. The wild Cardoon (*Cynara Cardunculus*) is another somewhat similar plant, but has a far wider range of growth than the giant thistle in South America. **

Here we must close our remarks upon the vegetation of the Great Plains, not because there is any dearth of much that is both interesting and instructive to relate, but because we fear to overload these pages with too great a mass of detail.

In like manner we must defer for the present all

* *Dictionary of Americanisms*, by J. S. Farmer.

† *Encycl. Brit.*, 9th Edit., Vol. xiv, p. 43, Article "Kentucky."

§ *Voyage of a Naturalist in H.M.S. Beagle*, by Charles Darwin, 14th edition, 1879, pp. 119, 120 and 148.

** *Ibid.*, p. 119.

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further consideration of the nature and habits of the wild animals which find their home in these broad pastures; until we come to the sections on hunting and shooting; where we hope to be able to consider these subjects somewhat in detail.

Meanwhile we propose to embody in the present section a short account of the Prairie Indians: the wild hunters and warriors who have inhabited the great plains region of North America from a remote period of antiquity. But a few years ago, these fierce and warlike savages used to scour over the billows of this grassy sea in numerous bands resplendent in all the panoply of barbaric paint and feathers, living upon the proceeds of the chase, and following the migrations of the far-famed buffalo, which then swarmed literally in myriads throughout the prairie region of the Far West. And now, both have passed away for ever, as it were like the phantom imagery of a dream—exemplifying in the most striking manner the transitory state of our earthly existence, even when applied to whole races of mankind, so graphically described in the Scriptural text, where it is said with dramatic pathos that "Our days on the Earth are as a shadow and there is none abiding." * So also, following the same strain of thought, Shakespeare, our own great master of dramatic description, has expressed this identical idea under a slightly different form, in the well-known passage beginning—"Life's but a walking shadow." † And as a shadow accordingly both the Indian and the buffalo have been relegated to the regime of history. Of course, as we know, some few drunken

* *I Chron.* xxix, 15.
† *Macbeth*, Act v, Sc. 5.

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and degenerate examples of the red man still linger upon the scenes of their former exploits; but as the wild hunter of the prairie—the Bedouin of the West—the Indian may be said to have vanished with the buffalo. Many of his supposed representatives at the present time are people of mixed blood, who it is to be feared inherit most of the vices of the white man, with but few or none of his virtues—and it is not a little remarkable to find that this is generally so with savage half-breeds everywhere: they rarely inherit either the physical or moral good qualities of either parent, but are an essentially degenerate race.

In connection with these and also other nomadic plainsmen, it is worthy of note that history shows that the natives of almost all the great plains regions in the world consist of fierce bands of robber horsemen, whose predatory forays have made them dreaded with the surrounding nations. Upon the great plains of North America these banditti are represented by the Red Indian prairie tribes; in South America, they are represented by the Patagonian savages and other pampas tribes, whose periodical irruptions from the southwards were the scourge of the pampas region until within quite the last few years; while the great plains of Central Asia were under the domination of the Turkoman and Tartar hordes, whose incursions into India and into Eastern Europe have frequently been recorded in history. Some of the invasions of these fierce barbarians were also marked by about the most fearful massacres that have been chronicled in human annals. Then in North Africa, and Arabia, the robber tribes of wandering Arabs have also left imperishable records of their scarcely less barbarous

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exactions of blackmail, and deeds of violence upon caravans of travelling merchants and other wayfarers. These men have been for centuries the terror of the oriental trader, and so continue still over large areas of South Western Asia.

The characters and modes of warfare of almost all these plainsmen bear a strong family resemblance, though they consist of manifestly different races. These points of resemblance are especially notable with regard to the Red Indians and the Arabs—many of their noblest characteristics are held in common, as also many of their faults and vices.

We have, however, already given some account of Arab life, which shows the many noble qualities with which this people is endowed; and it must be said that they have never been known to disgrace their name and creed by the grosser cruelties which we shall presently have to recount in the case of the American savage.

But in attempting to give an impartial sketch of Red Indian character and prowess it must be remembered that one treads upon somewhat thorny ground, because in America violent prejudices still exist upon this subject. As painted by some of the dwellers in the eastern cities, who have perhaps never seen a specimen of a really wild Indian, the red man is represented as a model of manly dignity and virtue—all his faults, if he has any, being represented as the results of ill-treatment by the whites. While the causes of frontier wars are in the same way set down to non-performance of treaties by the United States Government.

On the other hand, the same ideal red man, as

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depicted by the settler on the western plains, is simply a bloodthirsty fiend, without one single redeeming good quality: indeed, it used, as we have said, to be a common saying on the frontier, that "the only good Indian is a dead Indian."

It will therefore perhaps hardly surprise the reader if we venture, after consulting almost every available authority upon this subject, to adopt something like the mean between these two extremes; and while refusing to be blind to their many faults, still to recognise the many unquestionably fine qualities of this remarkable people.

That the Indians have had much to complain of, as the eastern people assert, there can be no manner of doubt; most of the treaties made with them by the United States Government being treated as so much waste paper by the western people: also where the treaties stipulated (as they generally did) for furnishing the Indians with goods, or rations—it is admitted on all hands that but a very small proportion of what was justly their due ever reached them; all the rest being fraudulently made away with by dishonest agents, contractors, and others. It is however but justice to the U.S. Government to observe that the treasury, generally, paid for these supplies upon an equitable and even liberal scale. This would however be no defence in law to the plea set up by the Indians; for the United States were responsible for the wrongful acts of their agents, and were manifestly bound to see that the proper parties were paid whatever was due to them.

It would be impossible however to enter into the merits of such questions in these pages; we shall there-

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fore merely observe that we think there is little doubt that most of the troubles between the U.S. Government and its Indian wards may be set down as generally resulting from these two principal reasons: (1) the non-performance of treaties, and (2) the illegal and aggressive acts of many of the white settlers.

On the other hand it would be absurd to suppose that the whites could view with equanimity the prospects of Indian raids upon their homes and families, even though these were ostensibly made in retaliation for notorious wrongs—nor would it be easy for us, in any mere words to convey, within reasonable limits, any adequate idea of the frequency, the extent, or atrocious barbarity of the outrages from which almost every part of the western frontier has suffered in turn, at the hands of the various Indian tribes; and in which unfortunately it was for the most part innocent persons who suffered for the misdeeds of others; for the Indian code of retaliation was by no means to seek out and punish the evil-doer; but revenge was taken upon the first unhappy white whom they might chance to meet, regardless of whether he or she had done anything to them or not. That being so, it can surprise no one that a pitiless war of races arose, where no quarter was either asked or granted on either side. How many innocent people of all ages and sexes were slain while crossing the prairies by the overland route to California, during the prevalence of the gold excitement for instance, will probably never be known; but the numbers must be something enormous. Thus so lately as 1866, before the troops which formerly guarded the frontier had returned after the conclusion of the civil war, we are told that according to the

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estimates of Governor Crawford, of Kansas, the butcheries of settlers and emigrants had during the twelve months amounted to some 5000 souls. * This calculation, we are told, was "received in the east with general distrust," but according to Mr. McClure, correspondent of the New York *Tribune*, who during a lengthened journey of "300 miles through the Rocky Mountains," had had every opportunity of learning the truth, from living witnesses resident on the spot, this estimate is held not to be exaggerated, and writing the fall of 1867 he says, that during that season—

"Hundreds of emigrants and settlers have fallen victims to the scalping knife. How many lives have been thus sacrificed, the nation will never know, as most of them have fallen without survivors to tell the story of their sad fate."—Then as regards what Governor Crawford had said, he continues—"Those who have spent any considerable time in the west, have good reason to know that the number given is not too large. I do not take up a paper published between the plains and Oregon, that does not record some fiendish savagery of the Indians; and there is hardly a cabin on the Platte, or Smoky Hill route, that has not the memory of the slain interwoven with its history." †

Again, many of the cemeteries, started on the foundation of the numerous mushroom cities, and frontier posts, which spring up throughout the western plains, are places where a man might acquire a nightmare that would not leave him for a week; for it is stated on the authority of numerous U.S. army officers, and others, who must have known the facts, that in many of them,

* See a series of Letters published by the New York *Tribune*, and other papers by Mr. A. K. McClure, republished in book-form, Philadelphia 1869, p. 355—Letter No. 38 of October 21, 1867.

† *Ibid.*, p. 355.

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at the period to which we refer, hardly one of their silent tenants had died in his bed. Some were slain in the frequent pot-house brawls that took place in these lawless regions; but in the vast majority of cases the record on the rude head-boards was "Killed by Indians" —"KILLED" shall we say?

Alas! many of these poor fellows were not only "killed," but had gone to their long homes after undergoing all the prolonged tortures which the ingenuity of these red fiends could invent.

And yet we are told by the eastern philanthropist that the blood of the western man had no cause to boil at the recital of these numberless atrocities! So deeply, as a matter of fact, was the whole cast of the western thought affected by the memory of these things, that the various Indian fights and "killings" served as milestones to record the dates of local events, and the distances, or exact locality, of particular spots, which the speaker desired to impress upon the minds of his audience.

Thus, an event did not occur last month, or last year, but—"Jes' about the time Pete Kitchen's ranch was jumped"—"The night before the Maricopa stage war tuck in"—"A week or two arter Winters made his last killin' in the Dragoons"—"The year the Injuns run off Tully, n'de long bull teams"—"Th'night arter Duffield drawed his gun on Jedge Titus"—and so forth.*

If a man wanted to explain to another how far it was to a certain point, it was not fifty miles, nor sixty miles, but rather—"Jes' on the rise of the Mesa (table-land), as you git to the place whar Samaniego's train

* *On the Border with Crook*, by John G. Bourke, Captain 3rd Cavalry U.S.A., published 1892, p. 64.

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stood off (beat off) the Apaches "—"A little way from whar they took in Colonel Stone's stage"—or "Jes' whar th'big killin' took place on th' long Mesa"—and much more to the same effect. *

Such was the state of society at the western frontier posts of the United States only a few years ago, when even in the towns a man would as soon have thought of going about unarmed, as of going about without his clothes. While most positively, if out upon the high plains, "a man had to keep his eyes skinned," in western parlance, if he meant to get back without "getting his hair lifted" (scalped). The old rule of the frontier then was this—"When you see Apache sign, be keerful, 'n when you don' see nary sign, be more keerful." † No man in fact could go for a mile in many places, beyond the limits of the posts, with the certainty that he would survive to return; and to pass from one town to another by the regular stage was a work of such imminent peril that no one could ever tell whether he would reach his destination alive or not.

And yet, there were men who from choice passed their lives as stage-drivers in such districts! although in that wild country, with only tracks for roads, one would have thought driving a team of half wild mules, by day or by night, would have afforded ample employment for the faculties of even the most adventurous man, without the additional excitement of a possible attack at any moment from Indians, under circumstances which might render successful defence impossible.

* *On the Border with Crook*, by John G. Bourke, Captain 3rd Cavalry U.S.A., 1892, p. 64.

† *Ibid.*, p. 27.

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These men were therefore of course always persons of daring courage and reckless character; who rather preferred living with their lives in their hands, to enduring the monotony of a quiet life; and in the end comparatively few of them, it may well be supposed, ever died in their beds. The Indians generally got them at last.

Captain Bourke gives us the following sketch of a well-known character of this sort, who used to drive the mail-coaches through the Apache country in Southern Arizona. At dangerous moments he generally used very wisely to make his trips under cover of the darkness of night, when the Indians could not see him. Moreover it is well known that on superstitious grounds, many of the prairie Indian tribes (the Apaches among the number), rarely make their attacks by night. Then making a wide detour, away from the beaten trail, he so arranged his movements as to reach his destination at dawn, before objects could be clearly distinguished at a distance. Yet, like the rest, this daring fellow got killed by the Indians in the end.

But we must leave the Captain to tell his story in his own way—

"The stage-drivers" (he remarks) "are an exceptionally profane set, and this one, Frank Francis, was an adept in the business. He has long since gone to his reward in the skies, killed if I mistake not, by the Apaches in Sonora, in 1881. He was a good 'square' man, as I can aver, and it was Frank's boast, that no 'Injuns' should ever get either him or the mail under his charge. 'All you've got to do with 'n Injun's to be smarter nor he is.—Now, f'r instance, 'n Injun'll allers lie in wait, 'longside the road, tryin' to ketch th' mail. Wa'al I never don go 'long no derned road. Savey?—I jes' cut right 'cross lots (farms), 'n dern my skin

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if all the Injuns this side o' Bitter Creek kin tell whar to lay for *me*'—and so the brave fellow would whip up his team, and taking 'a shoot off the road,' would never return to it until the faint tinge of light in the east announced that dawn was at hand, and Tuscon in sight."*

The annals of the western frontier are replete with incidents of this sort, and quite a library of interesting books has been written, containing accounts of the hairbreadth escapes and deeds of daring of a similar kind, which were of such every-day occurrence as to be looked upon almost as mere ordinary episodes of daily life. And this may be said to be true, in turns, of pretty well every part of the United States frontier throughout the prairie regions. At one time it was Texas, or Arizona in the South, that was the worst; but the most recent and principal instances of great "killings" have occurred in the north; as for instance on the occasion of the Sioux outbreak and consequent massacres in Minnesota, in August 1862, when about five hundred persons of all ages and sexes were barbarously murdered. A good many of the Indians concerned in these outrages were well known to the author of these pages. Then again there was the still more recent case of the attack upon General Custer, and the massacre of himself and nearly his entire command, by some of the bands of the same nation, under their celebrated War Chief "Sitting Bull," on June 25th, 1876; nearly three hundred United States officers and soldiers are said to have fallen on that fatal day,

Surrounded, as people on the frontier almost con-

* *On the Border with Crook*, by John G. Bourke, Captain 3rd Cavalry U.S.A., 1892, p. 93.

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stantly were, by these ever-present dangers and uncertainties; this nearly perpetual state of guerilla warfare begat in them a spirit of self-reliance and of sleepless caution and alertness, which probably made them the raw material of the finest soldiers in the world. For of course, in such a country a man was bound to be constantly on his guard, whether living at home, or travelling abroad; for no one could ever tell the moment when an Indian outbreak or attack might occur.

To small parties of hunters and travellers crossing the plains these remarks will naturally apply with still greater force, for their position exactly resembled that of soldiers on duty in the face of an enemy, upon active service of the most arduous and dangerous kind, where self-preservation alone compelled the maintenance of unceasing vigilance, ready to spring to arms at a moment's notice. And so long as this vigilance was never allowed to sleep, the Indians who, unseen themselves, generally watched and followed every party of strangers passing through their country, very commonly hesitated to attack a well-armed party, even with very superior numbers.

But such is the force of habit that men very often, after marching from day to day, for a long period, without meeting with any opposition, gradually became lulled into a false sense of security, which frequently proved fatal to them; for the moment the Indians observed the slightest signs of carelessness, or of any slackening of discipline, the fate of that party was sealed.

Colonel Dodge, whose great experience among the Indians of the Great West has enabled him to write decisively and to the point upon these matters, says—

"The Indian's great delight is the attack of a waggon

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train. There is comparatively little risk, and plunder is ample. For days he will watch the slow-moving line, until he knows exactly the number, etc., of men that defend it. If a direct attack involves too much risk, the next concern is to get possession of the horses and mules. He will follow the train, even for weeks, unseen and unsuspected, until, lulled into false security, the guardians become careless, and like a thunderbolt from a clear sky, the Indians rush into the herd with whoops and yells, scare it into a stampede, and in a moment all disappear together." *

Now as regards this fatal negligence and want of caution, we shall perhaps be pardoned for remarking, before proceeding further, that we have frequently observed and noted the vast difference that exists between the educated and the uneducated man, in this respect. To our own mind there is nothing which more clearly marks the different cast of thought, which distinguishes persons of the lower class from those above them, than this matter of systematic vigilance and caution. The common man may be induced to exercise vigilance *for the day*, but so far as our experience goes it is often almost impossible to get persons of the lower class to adopt any kind of *systematic* precautionary measures. Let any large employer of labour or director of works, or officers serving in H.M's forces by land or sea, think of this for a moment; and we venture to believe that few of them will be disposed to dispute the truth of this assertion. The immense difficulty of getting men of this class to observe the most ordinary precautions, even when working in the most risky and dangerous employments, is everywhere well known; and though

* *The Hunting Grounds of the Great West*, by Colonel Richard J. Dodge, U.S.A., 1877.

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the case of most people of the savage races, and also of white men wholly destitute of anything like book-learning, living upon the frontier, under conditions such as we have described, may seem to supply instances which are opposed to these views—we believe that they do so only in appearance.

That many of the scouts and plainsmen of the Great West (who are often wholly untaught except in the crafts and experiences of the wilderness) furnish us with remarkable instances of extraordinary and sleepless vigilance and sagacity, of which many a veteran soldier might take copy with advantage, we do not for a moment deny; we would merely point out, that if untaught in other respects, he is a man highly trained by a lifelong education in this particular way. Some of these men were models of unceasing watchfulness, and keen observation of all the signs of the wilderness, such as puts to shame the more highly educated intellect of his literary companion; but to our mind, this does not affect the force of the several observations which we have already ventured to make upon this head.

In continuation of the subject which we were discussing previous to this digression, namely the necessity for unremitting vigilance on the part of travellers passing through a hostile country, the observations of Mr. Cremony, who was Indian Interpreter to the U.S. Government boundary exploring expedition in Texas, under Mr. Bartlett, seem to us worthy of recording.

"You must never (he says) permit zeal to outrun discretion,—a well-appointed party may travel from one year's end to the other without ever seeing an Indian, or any trace of his existence; thus travellers become careless and fall an

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easy prey to their sleepless watchfulness. There are others who will not be convinced that the eyes of the Indians are always upon them, because they see nothing to indicate the fact; but the truth is, every move you make, every camp you visit, is seen and noticed by them with the keenest scrutiny. If they perceive that you are careful and always on your guard and prepared for any emergency, they will hesitate to attack, even with ten times your force, especially if the party does not offer sufficient inducement for plunder; but if they observe the least neglect you will be assaulted with every probability of their success." *

These attacks by the Plains Indians, as we have before remarked, were fortunately seldom made under cover of darkness, and although notable instances to the contrary may be cited, we believe it is generally admitted that on account of superstitions and other reasons they usually elected, in the vast majority of cases, to make their attacks by day; on this head Mr. Cremony further observes:

"Let it be borne in mind that the Apaches have hardly ever been known to attack at night. Under cover of darkness they will steal into camp, with wondrous skill, in hopes of robbery; but that is the extent of their night operations. Their onslaughts are almost invariably made by day, and at such times and places as tend to create the greatest sense of security. When they mean mischief, no marks are to be seen, no tracks, no signs observable, and the unsuspecting traveller is lulled into a fatal belief that no Indians are near, and is caught as surely as a spider catches the confiding fly." †

What is true of the Apaches, is true of pretty well all the Indian tribes, whose war tactics are generally

* *Life Among the Apaches*, by John C. Cremony, published 1868, pp. 138—9.

† *Ibid.*, p. 40.

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substantially the same all over the plains of the Great West. Surprise is their great weapon, and the basis of nearly all their operations. Attacks are almost invariably made with a view to take their opponents unawares; and where it is evident that "surprise" is not likely to succeed, the attack itself will generally be adjourned *sine die;* for the same reason night attacks, being peculiarly liable to miscarry, are probably unpopular with the Indians, and are seldom resorted to. This may explain their "religious" objection to them.

When darkness has fallen, the student of military history will be well aware, events may often so turn out as to render an attacking party the surprised, instead of the surprising. The wily Indian therefore prefers to see what he is doing, before risking his skin, and therefore generally elects to trust to his sagacity and intimate knowledge of the country to find a suitable opportunity to surprise his enemy by daylight.

The system of ravines and "couleés," which we have already referred to as constituting a feature of the plains regions, peculiarly lends itself to this species of attack, and forms natural hiding-places for a skulking enemy. The American General Custer, in his book relating his personal experience among the Plains Indians, gives a graphic description of an attack made upon a detachment of U.S. troops under his command under such circumstances.

"The escort (he says) was moving over a beautifully level plateau. Not a mound nor a hillock disturbed the evenness of the surface for miles in any direction. To the unpractised eye there seemed no recess in which an enemy might be

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concealed, yet such was not the case. Ravines of greater or less extent, though not perceptible at a glance, extended almost to the trail over which the party was moving. These ravines, if followed, would be found to grow deeper and deeper until they would terminate in the valley of some stream, and were the natural hiding-places of Indian war parties, waiting their opportunity to dash upon their unsuspecting victims. They serve the same purpose to the Indians of the timberless plains, that the ambush did to those accustomed to fight in the forests."

Then he goes on to show with what unerring sagacity the experienced scout who acted as guide to the party noted and commented upon the circumstances.

"Comstock's keen eyes (he proceeds to say) took it all in at a glance, and he remarked to Colonel Crook and Lieutenant Robbins, as the three rode together at the head of the column, 'Ef the Injuns strike at us at all, it will be just about the time we are comin' back over this very spot. Now mind what I tell ye all.'" *

How truly Comstock, a well-known and celebrated scout, had interpreted the course of events, was subsequently shown by an attack occurring exactly as he had prophesied, upon the return journey; which being anticipated beforehand, owing to his sagacity and warning, was easily repulsed with severe loss to the assailants. This is an admirable instance of the inestimable value of the services of those trained and vigilant, though otherwise illiterate plainsmen and warriors, many of whom, while apparently gazing abstractedly into space and taking no note of anything, are often, as we have repeatedly had occasion to

* *My Life on the Plains, or Personal Experiences with Indians*, by General Geo. A. Custer, U.S.A., 1865, pp. 63—4.

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remark, silently employed in taking in every feature of the country, down to its minutest details. *

We shall trouble our readers with but one other anecdote of this remarkable man, given upon another and more solemn occasion, when a young lieutenant of the U.S. Army, named Kidder, was missing, and as subsequent events proved had been waylaid and barbarously murdered with his whole command by a war party of Sioux Indians. The scout stood by, listening in silence to the opinions of the officers, who we are told,

"were grouped near head-quarters, discussing the subject then uppermost in the minds of all. Finally Comstock spoke as follows: 'Well Gentle*men* (emphasizing the last syllable as was his manner) before a man kin form any ijee as to how this thing is likely to end, thar are several things he ort or be acquainted with. For instance now, no man need tell me any pints about Injuns. Ef I know anything, it's Injuns; for you see Injun huntin' and Injun fightin's a trade all by itself, and like any other bizness, a man has to know what he's about; or ef he don't, he can't make a livin' at it. My experience among you army folks has allus bin that the youngsters among ye think they know the most, and this is particularly true ef they have just come from West Point. Ef some of them young fellars know'd as much as they b'lieve they do, you couldn't tell 'em nothing; but the fact of the matter is this, they couldn't tell the diff'rence twixt the trail of a war party, and one made by a huntin' party, to save their necks. Half on 'em, when they first come here, can't tell a squaw from a buck, because both ride straddle, but they soon larn. But that's neither here nor thar—I'm told that the lootinent we're talking about is a newcomer,

* Such instances too, make good what we have said as to the uselessness of mere book-learning to help a man to guard against the perils which beset him, when surrounded by the pathless wilderness.

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and that this is his first scout. Ef that be the case it puts a mighty onsartin look on the whole thing, and twixt you and me gentle*men*, he'll be mighty lucky ef he gits through all right." *

Again the sagacity of the scout had predicted correctly, for some time afterwards the dead bodies of the Lieutenant and his whole party of ten soldiers and an Indian guide were found frightfully disfigured and stuck full of arrows, by General Custer and the force sent in pursuit. The event took place in July 1867, near Beaver Creek in Nebraska, and General Custer thus describes the scene:

"We observed buzzards floating in the air; a rank stench pervaded the atmosphere, and hastening to the spot a sight met our gaze which even now makes my blood curdle. Within a limited circle were the mangled bodies of poor Kidder and his party, hacked and disfigured beyond recognition. Every one scalped, and his skull broken, except the Sioux chief Red Bead (their guide) whose scalp had been removed and thrown down by his side, in accordance with a custom prohibiting Indians wearing the scalp of one of their own tribe. Some of the bodies lay in piles of ashes, showing that the savages had put them to death by the terrible tortures of fire. The sinews of the arms and legs had been hacked off and the features so defaced that it would be impossible to recognise one of the victims. Each body was stripped, and pierced with from 12 to 50 arrows left sticking in them. The details of the fearful struggle will never be known, yet the surrounding circumstances satisfied us that Kidder and his men fought as only men can fight when the watchword is 'victory or death'." †

There can be little doubt that the party had been

* *My Life on the Plains, or Personal Experiences with Indians*, by General Geo. A. Custer, U.S.A., 1875, p. 74.

† *Ibid.*, p. 77.

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surprised and hunted by a very superior force of Indians, for the place was located in the midst of a thicket of bushes bordering the river, where a successful defence must have been exceedingly difficult, and where the chances were evidently all upon the side of the Indians. In fact they would not have attacked at all unless they had been.

It is not a little remarkable that General Custer, the officer who relates this history, was himself destined to perish shortly afterwards, in much the same sort of way, while in command of a very much larger force of United States troops. This event took place on June 25th, 1876, on Little Horn River, in Montana, and was one of the most disastrous engagements of the kind which has befallen the U.S. Army during modern times, General Custer and his whole force consisting of some 300 officers and soldiers having been almost completely destroyed by the united bands of Sioux Indians, some 2,500 strong, led by their celebrated War Chief, "Sitting Bull." In this case also the troops fell into an ambush, and after a most gallant defence were eventually overpowered and hardly a man escaped to tell the tale. Then again as regards Comstock, the scout of whose sagacity we have related some anecdotes, he too was in the end killed by the Indians in time of peace, while returning home from an Indian village after nightfall. A party of about a dozen young Indians suddenly attacked and murdered him for the sake of a beautiful white-handled revolver which the Indians had long looked upon with covetous eyes, as they supposed it to be of extraordinary value, because he constantly carried it, and always refused all offers made for it, no matter how tempting they might have been.

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It is possible that the poor fellow may have taken drink on that occasion, but however that may be, for once his customary vigilance slumbered, and so he too, notwithstanding that he ought to have been the last man to have let the Indians see him in possession of such an article, or to have trusted himself out alone with it upon him, at such a time and in such a place, fell a victim to an act of momentary want of caution and carelessness.

It is, however, "a good horse that never stumbles," and the case itself is worth noting and remembering, as an excellent instance of the fatal effects of even momentary want of caution, and also of the folly of exhibiting before the eyes of strangers in a wild country any article of great apparent value—there being no surer way of incurring the risk of being certainly robbed, and perhaps murdered, as in Comstock's case.

It has often been remarked that a series of outrages of this kind perpetrated upon the whites has eventually proved the precursor of an Indian war, and the fact of their occurrence is sufficient to show that mischief is certainly brewing; for the Indians, who are themselves universally strong believers in the law of retaliation, would never sanction the commission of outrages by members of their nation, unless they were prepared to face the prospect of war. Wherever, in fact, a civilized government has to deal with savage races, this same rule may be held to apply, namely, that the occurrence of an apparently organized series of outrages may be regarded as the almost certain precursor of an impending rising

The cruelties which always accompany the outbreak of savage warfare invariably form one of its most

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distressing features, for their implacable vengeance as a rule spares neither age nor sex, and it is considered equally meritorious for a savage warrior to destroy an infant or an aged woman, as to take the life of any one of the warriors attached to the enemy's camp. The red man has however always been conspicuous for his ruthless barbarity, the torture of prisoners following their capture where time and circumstances admit of it, almost as a matter of course; nor does his resentment end with the death of an enemy, for even the bodies of the fallen are almost always subjected to mutilation; nor is it at all difficult, according to Colonel Dodge:

"to tell from the nature of the mutilations whether the bodies fell into their hands before or after death; if it be pierced with many bullet holes, stuck full of arrows, cut or slashed with deep and careless gashes, the spirit had passed before the Indians got possession; but artistic dissections, flayings, dislocations, the breaking and splitting of fingers and toes, etc., indicate that the poor fellow went to his long home with all the accompaniments of pain and horror that these devils can devise." *

The process of regular torture practised upon captives is a subject over which we would willingly draw a veil, were its perpetration not already notorious; and we extract the following details from Colonel Dodge's book, which may be regarded as a high authority on all matters concerning the Plains Indians:

"The Indian" (as the Colonel remarks) "is thoroughly skilled in all methods of torture, and well knows that by fire it is the most exquisite, if it can only be prolonged. He there-

* *Our Wild Indians, or 33 Years' Experience among the Red Men of the Great West*, by Lt.-Colonel Richard J. Dodge, U.S.A., 1882, p. 538.

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fore resorts to it when time and opportunity serve. The victim is 'staked out' (that is, both hands and feet, stretched widely apart, are made fast to pickets driven firmly into the ground so that movement of any kind is almost impossible). He is then pleasantly talked to; it is the best kind of a joke. Then a small fire is built near one of his feet; when that is so cooked as to have little sensation, another is built near the other foot; then the legs, arms, and body, until the whole person has been crisped. Finally a small fire is built on the naked breast, and kept up until life is extinct." *

An instance of this kind occurred in 1868, when an attack was made by Sioux Indians upon a station on the Kansas Pacific Railroad. Some men who were herding stock in its vicinity were captured almost without resistance and carried off by these savages.

"The remaining two or three men successfully defended themselves, to the great exasperation of the red skins, who after losing several men, drew off. Just at nightfall they took their prisoners to a position in plain view, but beyond rifle range of the station, stripped them, and staked them to the ground, built a fire on the breast of each, and while some sat warming themselves with great apparent satisfaction, the others indulged in a dance of rejoicing. The cries and groans of the unfortunate men could be plainly heard by their friends, but nothing could be done; and it was not till far on in the night that the cessation of complaints proved that life was extinct. Next morning the Indians were gone, but the blackened and half burned bodies were found still fastened to the ground, scalped and terribly mutilated, and one, an unusually hairy man, almost skinned." †

Here we shall take leave of this revolting subject and proceed to give a short sketch of the redeeming

* *Our Wild Indians, or 33 Years' Experience among the Red Men of the Great West*, by Lieut.-Colonel Richard J. Dodge, U.S.A., 1882, p. 538.

† *Ibid.*, p. 529.

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qualities of Indian character. As we have already hinted, this portion of our subject will probably receive but scant acceptance upon the Region of the Great Plains, throughout America, where but few persons will be found to admit the existence of a single redeeming quality in the composition of the red man. The bitterness of race hatred is still too keen for that, and no suggestion of the kind would be listened to.

The immense natural sagacity which these people show in the way they make themselves at home in the midst of the wilderness, and the apparently marvellous faculty which they exhibit in interpreting the meaning of every sign left behind by man, or animals, in their goings to and fro, throughout their country, renders it absurd however to deny that they are possessed of talents of a certain kind, of a very high order.

Colonel Dodge gives the following picture of the solitary Indian thrown upon his own resources, in the midst of the plains of the great west:

"Unlike the white man, the Indian never feels so safe as when entirely alone. The fear of surprise is not entertained by the solitary wanderer. He has no fears for his rear, and in advancing he relies on his own sagacity and caution. He seldom makes a fire, and never sleeps near one" (neither the light nor smoke of it can therefore betray him into the enemies' hands). "If he sees signs of an enemy he hides himself in some place from which he can watch, and doubles and hides among rocks and thickets, forcing pursuers to hunt him by the slow process of trailing. In this way he protracts pursuit till dark, and under its friendly cover places as much distance between himself and the dangerous neighbourhood as possible." *

* *Our Wild Indians, or 33 Years' Experience among the Red Men of the Great West*, by Lt.-Col. R. J. Dodge, U.S.A., 1882, p. 554.

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Contrast this calm self-reliance and sagacity with the conduct of many a white man, temporarily losing his way, and left out even for a single night upon the prairie, away from his friends. It is by no means an unknown, or perhaps even a very uncommon circumstance, that sheer dismay and fright have actually deprived persons of their reason on such occasions, and they will rush aimlessly about at full speed, in the vain hope of finding their party, until they drop from exhaustion. This affection is known as "the plains madness" all over the prairie region of the great west; and one of its most characteristic symptoms is this impulse to keep constantly moving as long as the strength holds out, but without any definite object in view—indeed the victim generally wanders in circles.

The number of such cases which have been from time to time recorded are unfortunately very great, and instances have frequently been known where men have become so completely crazy with terror that they have fled from their own friends, who had come to their rescue and have had to be captured like wild animals, and forcibly carried back to home and safety.

The stoicism of the Indian is unruffled by all such considerations; indeed it is very doubtful if he ever loses his way for long. Should a dense fog, snow-storm, or darkness overtake him, he accepts the situation and like a sensible being, waits, and rests with unruffled stoicism until the obstacle to progress has disappeared. Nothing however can be more remarkable than the unerring instinct with which an Indian preserves his consciousness of direction and localities; he will guide his course, even through an unknown country, with undeviating certainty, directly to his objective point;

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no windings or turnings of the road rendered necessary by natural obstacles puzzle him; his knowledge of direction is as true as the attraction of the magnetic needle to the pole.

Nothing excites the unfeigned astonishment of the white man, first brought into contact with the red, more than this Indian faculty of never losing his sense of direction and finding his way from place to place, through the trackless wilds of nature. There are some few white men who acquire it, more or less, or perhaps some very few who even naturally possess it, but the gift is a rare one. A notable instance of a white man developing this inestimable gift of locality was observed in the late Confederate General Stonewall Jackson, whose conspicuous gallantry and military talents excited the admiration of the world during the war of Secession. He was not a "born soldier" however, for he was educated as a West Point Officer, though he had retired subsequently from military life, and had for some time before the war followed the homely calling of a schoolmaster and preacher.

And speaking of military genius—if there is such a thing as a born soldier, which may well be doubted—it is certainly to be found among the red men. The tactical skill, and high military talent for desultory warfare exhibited by the Indians, we venture to think, must be conceded by their bitterest enemies; and probably by none is this more frankly admitted than by United States army officers who have passed their lives upon the frontier.

Most of these gentlemen are themselves men of considerable attainments, in a military point of view, and well qualified to speak with authority on this

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subject. Colonel Dodge for example, thus speaks of his Indian adversary "Red Cloud," head chief of the Ogallalla Sioux; against whom he served in Montana, and who with conspicuous skill—

"avoiding any general or even serious engagement, so harassed all trains and expeditions that the few troops then in the country could scarcely be said to hold even the ground they stood upon. Several forts were established, and they protected only what was inside the palisades. A load of fuel could not be cut outside without a conflict. This at last culminated in the terrible massacre of Fort Phil Kearney, in which half the garrison perished to a man."*

Now Colonel Dodge with his long experience among the Indians of the Great West, we regard as an unimpeachable witness in such matters. No authority stands before his, and surely it would be difficult for one warrior to speak of another in higher terms of praise (in a military sense) than these. The poor Indian, fighting for the hunting grounds of his fathers, it must be remembered, had neither forts nor arsenals, nor hospitals, nor magazines to fall back upon. His basis of operations was the desert, and his scanty supplies were drawn from the stores which the Great Spirit above had liberally granted everywhere for the use of man and beast; but beyond that he had nothing but what he could carry with him upon his own person. That being so, he never had supplies sufficient to maintain any considerable force together for any length of time *in one place.* Savage warfare is therefore necessarily reduced to a war of outposts and detachments, operating independ-

* *The Plains of the Great West*, by Lt.-Col. Richard J. Dodge, U.S.A., 1877, p. 269.

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ently of each other, and constitutes at once both the strength and weakness of the wild man's position; but at the same time this description of warfare opens out unrivalled opportunities for the exhibition of individual prowess and gallantry of the highest order. There are probably few competent judges who will be disposed to deny the possession of these attributes, or military virtues, to the red warrior.

Take the instance of his conduct in the field as a cavalry soldier. What says Col. Dodge of him in this respect?

"Indians never receive a charge, and rarely make one. When charged, a portion of the array immediately in front of the charging force, breaks, and melts away into individual Indians. The broken Indians wheeling in circles, form on the flanks, to attack whenever practicable, or break again, when charged. Should an attacking force, carried away by excitement, become scattered in the pursuit, its defeat and destruction is almost sure. The magnificent riding of the Indian and his superb drill in this give him an immense advantage."*

Here again we venture to think it would be impossible to speak more highly of the Indian in his capacity of an irregular cavalryman.

Time and space will however prevent our following this subject into greater detail, and we shall proceed to sketch the Indian from the point of view of his moral worth. To be poor and at the same time to be honest, in the midst of plenty, and of temptation, has universally been regarded as moral worth of a very sterling kind. Can an Indian be said to possess this qualification?

* *Our Wild Indians, or 33 Years' Experience among the Red Men of the Great West*, by Lt.-Col. R. J. Dodge, U.S.A., 1882, p. 378.

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There can be no doubt that the degraded specimens of the Indian race who hang about the settlements are most of them thieves; nor can it be gainsaid that the Indian in his tribal capacity mostly lives by what we should call thieving; that is to say he prides himself on his skill in plundering waggon trains, and running off the horses and cattle of settlers; but he does so in his capacity of warrior, and regards the "plunder" as so much contraband of war, lawfully subject to capture; in the same way that an enemy's shipping is held to be a lawful prize by the navy of a civilized state. Without desiring to defend these Indian forays against innocent white settlers, there is still something to be said in mitigation of their conduct, for it must be remembered that their lands were being seized upon, and their hunting grounds destroyed, by white strangers, very often without even the semblance of compensation.

But when fairly treated, there is ample evidence to show that Indians have a strong sense of honorable feeling, in the repayment of debts, and in the fulfilment of engagements, when they enter into them with whites whom they know and regard as friends. Of this the Hudson Bay Company has had ample experience, and they found that when they trusted Indians with the necessary outfit to carry on the business of fur-trappers they almost invariable repaid the loan with strict honesty. We were personally assured of this by many experienced officers of the Company, who asserted that when an Indian failed to perform his contract it was almost invariably through misfortune, such as the loss of traps, or of peltries, illness, or other unavoidable causes.

Captain Bourke, U.S.A., makes the following ob-

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servations respecting the honesty of the Apaches, a tribe almost always at war with the whites, and one of the most dreaded of all the tribes upon the frontier. Some few of them however had entered the U.S. Military Service, and of these—

"no instance" (he says) "can be adduced of an Apache sentinel having stolen any of the Government, or other property, he was appointed to guard. Apache scouts, enlisted to carry on General Crook's campaign against 'Geronimo', remained for nearly a week at Fort Bowie, and during that time made numbers of purchases from the post trader, Mr. Sydney R. De Long. These were all on credit, and some months after, wishing to learn something definite in regard to the honesty of this much maligned people, I went to Mr. De Long and asked him to tell me what percentage of bad debts he had formed among the Apaches. He examined his books and said slowly, 'They have bought $1780 worth, and they have paid me back every single cent.'—'And what percentage of bad debts do you find among your white customers?'—A cynical smile and a pitying glance was all the reply vouchsafed."*

Mr. Delano, an Indian Trader in California and Oregon, gives his testimony to the same effect:

"I was completely in their power, and might have been killed or robbed at any moment" (he tells us) "but while I was with them I was not aware that I lost the worth of a dollar, though I had $5000 worth of goods with me at the time. Yet they would steal from passers-by, but my confidence in them was never abused."†

This makes good what we have already stated respecting the peculiar views of Indians in the matter

* *On the Border with Crook*, by John G. Bourke, Capt. 3rd Cavalry U.S.A., 1892, p. 124.

† *Life on the Plains and in California*, by A. Delano, 1857, p. 310.

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of honesty. They may steal, but will respect the property of traders living in their midst, with whom they have business relations, in accordance with the terms of the old adage "There is honour even among thieves."

We might go on to cite instance after instance in proof of what we have here advanced, did space admit of it, but we must bring this section of our work to a close, and passing further towards the snowy regions of the North, we shall have another opportunity of depicting the red man under the leafy shadows of "The Great Forest Region of the Temperate Zone."

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CHAPTER IX.

THE GREAT FOREST REGION OF THE TEMPERATE ZONE.

Small Proportions of this Zone in the Southern Hemisphere. Its Geographical Limits. The Bush Forest upon its Arctic Margin. Influences of Ocean Breezes upon Tree Growth. The Primeval Forest of Ancient Europe. Great Britain as a Forest Country. The Royal Engineers as Forest Sappers. Forest Growths within the Arctic Circle. The Primeval Forest of Canada. The Intense Severity of Winter before the Clearances. The Influence of Human Agency in the Modification of Climate. Evolution of Life upon Ocean Islands. Seeds conveyed by Natural Agencies for Immense Distances. Mr. Darwin's Experiments. Spring Arrivals of Geese in Canada with Rice in their Crops. Polar Bears on an Iceberg at Sea. The Question of Islands being "Cuts off" from Ancient Continents. The Irish Fossil Elk. A Norwegian Forest. The Formation of Straight Poles. Modern Destruction of Ancient Forest. The Process of Clearing the Forest in America. Ruthless Destruction of Timber and Game. American Backwoods Settlements. Making a "Deadening." Felling the Forest. "Making a Fall." Preparing for a "Burning." Extraction of Stumps. Estimate of Expenses in Clearing American Forest Lands. Dexterity of American "Lumberers." The Forest in the Eastern United States now. Singing Birds and Animal Life in the American Forest. Difficulties in finding Game experienced by a New-Comer. Fatigue of Walking through Forests. Alder Swamps and Thickets. Burnt Areas. "A Windfall." The Track of a Hurricane. Game Paths. Forest Lakes. The "Fly Season." Beelzebub or "The God of Flies." General Limits of the "Fly Time." The Primeval Forests on the Pacific Coast of North America. Foliage and Growths of Vegetation in the Tropical and Temperate Zones compared. Their Timbers Contrasted from a Commercial Point of View. British Naval Experiences of Timbers. Natural Arcades in the Forests of N.W. America. Pine Needles. Undergrowths. Forest Ferns. Night in a Forest Camp. Firelight Reflected on Silver Firs. The Forest Floor a Nursery and a Tomb. Fallen Trees. Timber turning to Mould. The Process of Change in Living Tissues. Infinite Variety of Life in a Great Forest. Insects. Parasitic Growths. Lichens. Fungi. Mosses. The Forest Soil. The Great Net-work of Roots. Ants. Insect Pests. Mosquitoes and Malaria. Fever and Ague in England in Ancient Times. Insect Life in the Tree-Tops. Bees and Bee-Trees. Native Prophecies in America and New Zealand respecting the White Man and his Importations. Tree Life. American Forests Eastwards of the Mississippi.

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Early Trails and Settlements in the Forests. Isolation of some of these Backwood Clearings. Beauty of Vistas upon Forest Streams. The Sioto 150 Years ago. Buffalo in the Forest Meadows. Birch Bark Canoes. The "Canoe Birch." Value of Birch Bark. Carrying Capacity of Birch Bark Canoes. Their Seaworthy Properties. Shooting Rapids in Canoes. The Great Pine Trees of N.W. America. The Pinus Strobus. Forest Lumbermen. Mr. Lambert on Great Pine Trees. The Douglas Fir. The Great Trees on Burrard Inlet. Historical Age of a Great Pine. Great Flagstaffs. Pendant Tree Mosses. Great Fern Brakes. The New Westminster Trail in the Early Days of British Columbia. The Frazer River. A Great City Rising in the Wilderness. Great Cedars. Queen Charlotte Islands Canoes. Sea-going Canoes of the Hydahs and other Tribes. Raids by Fleets of Indian Canoes. Cypresses. Great Silver Firs. Picea Magnifica, Picea Nobilis. Pitch Pines. Sequoias. The Big Tree Groves of California. Destructive Effects of Forest Fires. Vitality of Ancient Trees. Great Trees of the Southern Hemisphere. Eucalypti. A Mammoth Eucalyptus. Foliage of Australian Gum Trees. Australian Hot Winds and Droughts. The Blue Gum as an Anti-malarial Tree. "Disinfectants" and "Deodorants." Water-Absorbing Trees. Scented Eucalyptus Leaves. The Kauri Pine of New Zealand. Kauri Gum. The Succession of Forest Growths. Nature's Great Rotation of Forest Crops. Vast Age of Forest Growths. Pine Seeds. Dormant Germination. Why New Varieties of Trees supplant the Old. The Chemistry of Nature. De Candolle on the Excreting Power of Roots. The Question of the Exhaustion of Soils. Change the Universal Law of Nature. The Darwinian Theory of "The Survival of the Fittest." How Nature does her own Pruning. The Work of Creation as a Self-Regulating and Self-Perpetuating Power. Natural Tints and Colours in a Great Forest. Beauties of Tints in the American "Fall." The Sleep of Plants. The Winter Rest of Plants. Man as an Inhabitant of the Forest. Red Indian Forest Tribes. The Indian of Cooper's Novels. "The Last of the Mohicans." The Story of "Cora." Daniel Boone of Kentucky. His Pursuit and Rescue of Girls carried off by the Indians. Cora detected "Marking the Trail." Tracking and Trailing in the Forest. Human Footsteps. Reading the Signs of the Wilderness. Frontier Scouts. Forest Warfare. The British and the United States "Indian Policy" contrasted. An American Bishop on "King George's Men." Respect for the Memory of King George III. Indian Trails and Footmarks. Ancient Forest Paths. Indian Ambushes. Border Raids. Arrow Wounds. Hunting Arrows and War Arrows. Backwoodsmen in the early Colonial Days. Indian Attachment to their Forest Homes. Adoption of White Strangers by the Native Tribes. General Bouquet and the Ohio Indians in 1764. Demand for the Surrender of all Captives. White Captives refusing to Leave the Indians. Pathetic Scenes and Romantic Incidents. The Whites Carry off the Captives by Force. Ancient Frontier Posts. Detroit. The Conspiracy of Pontiac. The Garrison of Detroit saved by an Ojibwa Girl. The Night before the Rising. Indian Councils. Pontiac and his Indians Received by the British Com-

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mander. The Garrison Awaiting the Indian Signal of Attack. Pontiac's Speech. The Signal. The Plot Fails. Military Questions involved in the Defence of a Forest Frontier. Wild Fowl and Fish in the Great Lakes. The Liquid Highways of the Forest. Canoe Paths. Frontier Towns and the Indian Trade. Two Celebrated Frontier Posts—Forts Duquesne and Oswego. British Operations against Fort Duquesne. Braddock's Defeat. The Place Captured at last. Oswego and the French Operations against it. Political Importance of the British Northern Line of Frontier Posts in the French War in America. The British Indians. "The Six Nations." How their Loyalty to Great Britain was maintained. The Military Importance of Internal Water Communications in a Great Forest Country.

THE Great Forest Region of the Temperate Zone constitutes the fifth in order, counting from the equator, of the terrestrial zones into which we have ventured to divide the earth.

This region is however practically extinguished in the Southern Hemisphere by the vast preponderance of ocean existing there; moreover a glance at the map shows us that the great continents are, almost without exception, drawn out to a point at their southern extremities. Why this should be so is perhaps beyond our province to enquire; and yet there must be a reason for it, for the work of creation has not proceeded haphazard: of that, at all events, we may at least feel sure. Probably the forces which at a remote period of geological time, upheaved the land from beneath the billows of the ancient sea, operated with greater intensity in the northern, than in the southern half of the globe, and so it comes to pass that the proportion of land is there much greater. But this must probably always remain a matter of conjecture. It is sufficient at present for us to note the fact, that this is so.

The southern limits of this great zone we venture to locate at about the 50th parallel of North Latitude,

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where the Region of the Great Plains is supposed to terminate; and it extends northwards as far as the arctic circle, which is drawn by geographers at Latitude $66^{0}32'$ North. This zone thus occupies a belt as near as possible 1000 geographical miles in width. At some points, as we ourselves have seen, the region of trees surpasses these limits, but if so they are of dwarfed growth, and the heavy forest has almost completely ended: a region of stunted bush, growing in patches, nevertheless in many places extends some distance into our next and last division, namely the Arctic Zone, before tree life finally ceases. In the southern hemisphere, the mighty expanse of the great southern ocean occupies, as we have said, nearly the whole of the corresponding area in that part of the world. The reports of navigators show that it is a region of almost constant storm, where the giant rollers driven by the westerly gales continually chase each other with little intermission round the world in that region, throughout the year.*

In the previous section we have drawn attention to the influence of the ocean breezes in promoting the growth of trees, and have pointed out that in consequence the whole of the eastern seaboard of the United States was formerly a region covered with dense forests —which usurps the position which would otherwise be occupied by open plains; but that as the influence of these water-bearing winds ceases, so the forest also ceases, and the treeless plains take its place. It would not now be easy to define the exact boundary line

* These gales are known by mariners as "The Brave Winds"—which blow almost unceasingly in the Southern Hemisphere, from about Lat. 40 S., in a stiff westerly gale.

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in North America where the forest ceased and the plains began, (the trees having been cut away to so great an extent,) but it is certain that the limits of the forest bear away sharply to the eastward, as we go northwards—that is to say, the area of the forest in the southern states is much greater, and runs much further to the westward than it does further north. To the southward it often passes considerably to the westward of the Mississippi River, whereas in Illinois the treeless plains come a long distance to the east of that river, whose course, roughly speaking, is pretty well north and south.

It is evident that the influence of the wind, blowing across wide areas of water, is the principal cause of tree-growth; because when we pass still further to the north, the winds passing across the region of the great lakes again bring the forest growth into being, in the States of Wisconsin and Minnesota: a region full of beautiful lakes, scattered through the wooded country, as a glance at the map will show. The same cause would also seem to account for the existence of large areas of forest in Canada, where the great lakes lay almost completely embosomed in the depths of the primeval forest, as all early accounts left by the French Jesuits and other missionaries conclusively show.

So also ancient records inform us that most of Western Europe was in ancient times a forest country, and in Scandinavia and Russia a great deal of country is so still.

Great Britain, for instance, was, as we know, once itself a forest country, and was probably covered from sea to sea with a luxuriant growth of trees. It is sufficient to refer to any of the histories of England, relating to the

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Saxon times, to find ample authority for this; historians being pretty well unanimous in admitting it.

Curiously enough our oldest military corps, which still form part of the British army, the scientific corps of Royal Engineers, was first organized as "sappers," furnished with tools and appliances for cutting roads and trails through these great natural forests. The first military engineers are believed to have come over with William the Conqueror in 1066, and Waldivus, who was chief engineer to the Conqueror, may be regarded as the first commanding officer. The Royal Engineers can thus show a longer continuous history than any other branch of the British army; and we are told that 120 years afterwards—"When Edward I. conducted the war in Wales in 1287, there were 2000 cutters and 'sappers' (*Fossatores*) employed with the army, and these men were of great service both in making roads, cutting paths through the forests, and assisting in the sieges of the Welsh strongholds." *

The plentiful rains and water-bearing winds which prevail from the south west, would here (in Western Europe) seem to be the agents which promoted the tree-growth upon the wild lands in former times, except where the sterile and mountainous nature of the country forbids. There heathy moorlands took the places of trees.

Then the same feature which we have remarked upon in North America recurs in Eastern Europe—the open plains or steppes appear in Southern Russia, and continue almost without a break right across Asia to the Great

* *The Army Book for the British Empire*, by Lieutenant-General W. H. Goodenough, R.A. C.B.; Lieutenant-Colonel J. C. Dalton, R.A., and others, official publication, printed for H.M's Stationery Office, London 1893—Part ii, p. 236 (Article "The Royal Engineers").

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Wall of China: the forest region being pushed further north into Siberia, and there covering the face of the country as far as the Arctic Circle.

In the article on The Polar Regions in the *Encyclopædia Britannica*, which may be taken as an authoritative compilation from all the best available sources of information, it is stated that—"In the Polar regions the line of forest seldom reaches to the Arctic Circle; low birches, willows, and shrubs, bearing berries, occur in South Greenland; but further north a creeping willow alone forms wood." * This we conceive applies merely, as we have already stated, to the heavy forest. As the severity of the climate increases, its effects are seen in the stunted growth of the trees, but still very fair timber poles may be here and there found growing, as far north as the Arctic Circle, and therefore we venture to think that though larger and more valuable sorts of timber are rarely found so far to the northwards, still that the forest, in the shape of a low-growing *bush forest*, does extend in most places up to 66° 32' N., where the Arctic Circle is drawn upon our maps; and we hope to be able to give some curious and interesting details of tree-life as observed even beyond these limits, in our next, or arctic section.

Those who are acquainted with Swedish Lapland for instance, will not fail to have noticed that tree-life ascends beyond the Arctic Circle there. Ascending the splendid river Luleä, for example, the map and guide books show this circle cuts at Mattis Udden, a post station on the road, slightly to the south of Jock-mock, a place dear to lovers of the gentle art, on account of the admirable fishing to be sometimes

* *Encyclop. Brit*, 9th Edition, Vol. xix, p. 328.

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had there on the rapids below the falls: now timber follows this river, and skirts the lakes almost all the way up to Quick-jock, considerably further to the northward, and even beyond that point dwarf pine forests exist. A large trade in very fine timber is done on the Luleä and other rivers entering the northern portion of the Gulf of Bothnia: whose shores are covered almost everywhere with dark pine forests—so much so indeed that travellers are often heard to complain of the monotony of its scenery on this account. On the Russian side of the gulf the same thing occurs.

On the Norwegian coast, too, numerous travellers will be aware that timber is found on the fiords and rivers, beyond the arctic circle; and those who have visited the coasts of Alaska (formerly Russian America) will be aware that the same statement will apply there also.

Though the intense severity of an arctic winter is as we see adverse to the growth of trees, doubtless because of the shortness of the annual period of growth and the prolonged sleep of plant life during the cold period: it is not a little remarkable to find that a forest covering to the earth is a great factor in retarding the spring growth, and in increasing the rigour of the climate generally. This has been put almost beyond a doubt by the evidence of the early Canadian records, which show that there has been a material improvement in the climate there since the opening up of the country by settlement, and the consequent clearing of the forest; and if we think of it for a moment, it is evident that the canopy of branches overhead must seriously interfere with the action of the solar rays, in melting snow, and loosening the iron fetters with which the frost has bound up the earth.

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Agriculturalists also tell us of the marked effect exercised by drainage, which enables the heat of the sun to penetrate more deeply into the soil. Works upon the science of agriculture are unanimous in pointing out that by draining away the surface waters which saturate the soil, a vast improvement is effected, on account of the known fact that water is an exceedingly bad conductor of heat.

It is probable that the influence of human agency in the modification of climate is nowhere more clearly or strikingly exhibited than in the act of disafforesting the earth's surface. The length of the northern winter is curtailed, and its rigour diminished. On the other hand, the intensity of the tropical heat is increased by the removal of shade—the droughts are prolonged, the rainfall lessened, and the process of erosion which we have spoken of in connection with the formation of cañons and other denudations of the soil, by torrential rains, is enormously and destructively increased.

It would be too long to enter into this question at greater length; the records of the island of St. Helena however, conclusively show the injurious effects of the removal of the forest there. When this island was first discovered by the Portuguese, in 1502, it was covered with a dense growth of luxuriant forest, and possessed a soil of remarkable fertility, which now, since the removal of the trees, presents an aspect of sterility so great—

"that it is difficult to believe that it was once green and fertile. When the vegetation was destroyed, the heavy tropical rains washed away the soil, and left a vast expanse of bare rock and sterile clay. This irreparable destruction" (we are

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told) "was in the first place effected by goats, aided by the reckless waste of man." *

The question as to how vegetation and animal life was first evolved upon these specks of land, situated in the midst of the melancholy ocean, is a curious one, which has much exercised the minds of thoughtful naturalists. It is evident that the problem as regards animal life is surrounded by many and great difficulties, which do not apply in nearly the same degree to the question of vegetation.

Nor can any of the theories be accepted as very satisfactory, with reference to the former, in such a place as St. Helena, with its beetling cliff, and deep water extending almost to their very base.

That small seeds may be carried by the winds and by the agency of birds to very great distances is a well-known fact. Some of the larger seeds also have been known to float or to be carried by currents, adhering to branches, for long distances across the sea, without losing their vitality. Then again there is hardly any apparent limit to the distance to which seeds may be carried, adherent to the feet and feathers of birds. Mr. Darwin, whose remarks on this subject are quoted by Mr. Wallace, states that he has found mud adhering to the legs and feet of many birds, and in some cases has reared plants from the seeds thus adhering to their legs, after they had been shot and brought in, having flown perhaps long distances; and Mr. Wallace states that—"Mr. Darwin has shown by experiment that almost all earth contains seeds. With 6¾ ounces of mud from the edge of a little pond, carefully treated under glass, he produced 537 distinct

* *Island Life*, by Alfred R. Wallace, 1880, p. 51.

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plants. This is equal to a seed for every six grains of mud." *

These curious facts will in a measure explain how plant life at least is started upon a desert island which has risen from beneath the waves; moreover in the crops and droppings of birds we have another source from which abundant supplies of seed may be transplanted across wide stretches of ocean, and deposited upon islands, in what is often the best condition for rapid germination.

For instance, during the great spring migrations of the Canada geese (*Brenta Canadensis*) crossing New Brunswick about the middle of March, on their way to their nesting grounds in the polar regions, it appears not to be an uncommon circumstance to find "grains of rice and maize in their crops, showing that they must have flown many hundreds of miles in a single night," after feeding upon these seeds in places where they are produced. † Now *rice* is probably carried from as far south as the Carolinas, where it is in many places a staple grain; this therefore presents a wonderful instance of the great distances seeds may be carried by birds; and from the circumstance of its being still found in the crop, there can be little doubt that its vitality would be uninjured, especially as both rice and maize are *hard seeds*. At the period of the year to which we refer the ice is still generally thick upon the greater part of the New Brunswick waters, and these geese, Mr. Rowan, an intelligent an careful observer, informs us, are generally shot at that time, from screens, or "hides," erected upon the ice." §

* *Island Life*, by Alfred R. Wallace, 1880, p. 250.

† *The Emigrant and Sportsman in Canada, Experiences of an Old Settler*, by John J. Rowan, 1876, p. 117.

§ *Ibid.*, p. 117.

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It is also conceivable that even large animals may be transported for long distance by means of ice, and other floating objects. Thus during the summer of 1892 two large polar bears were seen upon an iceberg, which had drifted so far south as to be carried across the track of steamers proceeding from Europe to the United States. They were sighted by the steamship *Ems*, upon May 21, on her passage from Bremen to New York, and were at first imagined to be human beings; the steamer's course was in consequence changed, so as to bear closer in towards the berg; when it was ascertained that they were polar bears, no further attempt was therefore made to rescue the adventurous voyagers, and the steamer proceeded on her way.* It has also been supposed that islands have been cut off from the mainland by subsidence, and other great convulsions of Nature, and that some of the creatures of the ancient world have been thus preserved until the present time: these creatures continuing to live and breed upon the island, and so have perpetuated their species until now. All that need be said upon this head is, that it may be so; but even in that case, it only removes the mystery as to the original evolution of animals by a single step; for it still fails to explain how they came to inhabit the mainland *before* the island became detached from it. Certain however it is that very wonderful and strange animal forms have been known to exist on islands. A good instance of this is the wonderful extinct Irish fossil moose or elk (*Cervus Hibernicus*), specimens of whose horns have been found, measuring at least ten feet across from top to top in a straight line.

* *Scientific American Newspaper* of June 4, 1892.

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Mr. Glennon, the well-known naturalist of Dublin, had a pair of horns 9 feet 6 inches across, by 16 feet 6 inches measured along the curve. The height of the skeleton from the hoof to the top of the dorsal vertebræ was 7 feet 6 ins., and when standing with the head up, it would require 18 feet head room. * Again the late Lord Enniskillen had a head and horns in his museum at Florence Court, which we think must have been even larger than this. The moose, as we know is an inhabitant of dense forest, and is to a great extent a tree-feeder; the remains of enormous trees found in the bogs also show beyond a doubt, that in remote times Ireland was a forest country, covered with magnificent timber, beneath whose shade this great elk found a congenial home.

The great natural forest which once covered Western Europe has however of course long since been swept away; nevertheless, in Norway, Sweden, Finland, and Russia, remains of it still exist which give a very good idea of what it used to be in bygone times. Most of the finest specimens of timber, however, have been cut for commercial and other purposes; still even so, the forest still existing in the interior of any of these countries is well worth seeing.

The scenery throughout the Norwegian forests in the first place is often magnificent, and vistas of distant hills and valleys, seen from the crest of a ridge, often present pictures of natural beauty enchanting to every true lover of nature. As a rule the trees are not very large, and consist mostly of dark spruce firs, growing thickly together, almost like a field of corn. The consequence is, of course, that all the lower branches have

* *Echoes from the Backwoods*, by Levinge.

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died back, and a feathery head alone surmounts a lofty pole—mostly grown straight and even as a bulrush.

These poles are cut in millions, and shipped to England and other places, as scaffolding and telegraph poles; and by inspecting the scaffolding of any building in process of erection in London, the dwellers of that great wilderness of houses can form a very fair idea of what a Norwegian forest is like, where these tall, symmetrical little trees may be frequently found growing over a large area of country so closely together that it is not always easy to pass between. The hoary hand of antiquity has however everywhere left its mark throughout these forests, in dead and decaying timber, which together with many of the living specimens, is festooned with dark grey pendant mosses, swaying in the wind. At every few steps some picturesque object is generally found to adorn the scene, such as weather-beaten, lichen-covered rocks, masses of fern, or bilberry, or other dwarf undergrowth, and it is rare to travel far without meeting some crystal brook, whose ice-cold waters descend from the frozen fjeld above.

As usual in every forest country at the present day, bands of wood-cutters work destruction throughout these ancient forests; through which the trails by which they have dragged the fallen timber down to the neighbouring river are everywhere to be found, upon whose waters it is thence floated down to the sea, and exported, or sawn up for local consumption.

The destruction of the forest in this way is everywhere a grievous spectacle to the lover of nature. In Europe, however, there is generally some local authority, and often stringent laws, to control and prevent wanton waste or wholesale destruction; judicious thinnings may,

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as we know, be carried out among growing timber, not only without injury, but with very great benefit to the remaining trees.

But it is in America, where no control was exercised, that the most wholesale devastation was to be witnessed; and to such lengths has it been carried, that even the vast and apparently inexhaustible expanse of virgin forests have already come within a measurable distance of extinction, at all events upon its eastern watershed.

The process of clearing away the forest is generally effected by means of fire; the trees being felled, and left for a time to dry, until a favourable moment for applying the torch arrives, when if the burning is skilfully planned, everything except the stumps was generally consumed. Unfortunately however, fire, which has always proved an admirable servant, like many a man, often shows itself but an indifferent master; and once the devouring element was set a-going, it was not always possible to place a limit upon its ravages; so that not infrequently, after a spell of dry weather, the fire passed beyond the boundaries of the intended clearing, and set the whole forest itself in a blaze; where the fire continued to rage and burn for weeks and even for months together, till it sometimes laid waste hundreds and possibly thousands of square miles of magnificent primeval forest. We shall have more to say upon the subject of these great forest fires and clearances hereafter; enough has however been said to indicate the fearful extent of devastation that has been wrought by the ruthless spirit of selfish recklessness, which knew no single restraint where the personal interest of the hour seemed to stand in the way of the individual. It was the same with the game;

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everything with hair or feather was shot and slaughtered wholesale, at all seasons; and North America, which within living memory was one of the finest all-round sporting countries in the world, has in consequence now become probably the poorest of any of the great continents in this respect.

These things have long been viewed with mingled feelings of shame and sorrow by every true American sportsman. Poor old "Nessmuk" for instance, *—the well-known American wood-poet and writer on matters of forest shooting and wood-craft (who has but recently passed away), as he every year beheld fresh scenes of devastation and ruin, wrought upon the sylvan beauties of some beloved haunt of his youthful days, where he was wont to hunt the wild deer, or angle for the speckled trout, while encamped in some secluded nook upon the borders of the woodland streams—was full of indignation at this wicked and senseless waste of the treasures which should have been the heritage of posterity; and before he died, gave vent to the bitterness of his spirit in his book upon Woodcraft, in which with ironical scorn he rebukes the covetous folly of the age, which was ready to sacrifice *everything* to the lust for gain.

"Of course this is progress" (he says) "but whether backward or forward had better be decided sixty years hence! It is the same old story of grab and greed. Let us go out" (he continues) "on 'the make' to-day, and 'whack up' to-morrow; cheating each other as villainously as we may: and posterity be d——d; 'What's all the w-u-u-rld to a man when his wife's a widdy.'" †

* Mr. George W. Sears (the word "Nessmuk" signifies *wood-duck* in the Indian language of the Narraganset tribe).

† *Woodcraft*, by Nessmuck, p. 90.

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The harm however, it is to be feared, is now irremediable, though some efforts are at last being made to preserve the wreck of what is left—by appropriating some of the most remarkable spots as national parks, or grounds for public recreation; and, all too late, some laws for the protection of game have also been passed; but the remains of Nature's former beauty and magnificence are now only to be met with in isolated spots, few and far between.

Nothing more painfully impresses the traveller who loves Nature, than the aspect of one of these modern American settlements, notwithstanding its perhaps grand name; a collection of a few log houses and drinking saloons, dubbed a "city," having very likely appropriated to itself some illustrious title, borrowed from the historical annals of the Old World. The European traveller can at times hardly repress a smile at this absurd and obvious incongruity; the utter want of respect for history and antiquity, however, proves none the less offensive to his sense of decorum.

This however by no means detracts from the heartiness or the hospitable reception he meets with at the hands of the worthy citizens, who generally welcome the new-comer with the hope "that he will conclude to settle there." We remember reading of one of these cases, where the stranger, who showed some signs of disappointment and doubt as to whether the place would suit him, was promptly reassured by a local celebrity, something to the following effect: "Oh! you'll not find —— such a bad place after all. There's many worse places than —— in the West; for you can always get a drink in ——; but there's places out West where you can't get a drink." Whether in view of

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the last terrible eventuality, the stranger "concluded to settle" or not, deponent sayeth not. It is not easy however to conceive a scene of more utter desolation than some of these spots recently set down in the midst of the primeval forest, at first necessarily display. To use a cant phrase of the acute Yankee trader—"The forest is rapidly disappearing before the industry of man"—and on every side a wilderness of burnt stumps accordingly appears, studding the ground throughout the clearing, which is enclosed by the black walls of the pine forest rising all round it to a vast height.

On this head we feel bound to add a few words of explanation, for a clearance of the forest is unfortunately the first step which settlement renders imperative: experience having again and again proved that it is exceedingly dangerous to leave old trees standing anywhere in the immediate neighbourhood of settlers' houses; because once a breach has been made in the forest, any such trees left standing, for ornament or shelter, are almost sure to come down in one of the violent storms which are of such frequent occurence in the interior of great continents—and numerous fatal accidents have occurred in this way.

It may perhaps be interesting to Europeans, or to the dwellers in cities, to give a short account of the process of clearing forest lands.

There are two ways by which this is usually effected—the first and quickest by what is called a "deadening," that is to say (the underwood and small trees having been first removed) the large timber is all destroyed by having a ring cut in the bark round the trunks, after which the trees, of course, speedily

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wither and die. The sunlight then for the first time is able to penetrate to the soil, and crops are sown among the dead stems of the standing trees, which gradually rot, and in course of time fall to the ground. This, as the reader will see, is an inexpensive and speedy, though rough and primitive process; handed down there is little doubt, from the old Indian times, when the forest tribes occasionally made small clearings of this kind, wherein they sowed their scanty crop of beans or maize. The white settler was not slow to follow their example; but the plan is open to many objections, notably to the danger incurred by men and cattle from the fall of rotten branches, whenever there are gusts of wind.

The other and more effective process is an actual clearance of the timber by means of axe and fire. A spot is chosen for the dwelling house and the settler proceeds to fell some of the most suitable trees, to cut into lengths for the construction of the first log cabin. The brushwood is then removed throughout the extent of the proposed clearing, and is piled into heaps to dry for burning. The larger trees are next attacked, and the woodsman cuts each tree partially through, a few feet above the ground; the cuts being in each case so arranged that the trees may all fall in the same direction; when a sufficient number of trees are thus cut, in a row, one behind the other, a fall is made, a big tree at the furthest end being selected, which is cut through and thrown upon its neighbour: when if the fall has been arranged with judgment, the whole row go down, one after the other from end to end, like a house of cards. The crash is of course tremendous, and as the traveller passes in the distance along some of the forest trails,

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his ear is not infrequently startled by the ominous sound of one of these falls, whose appalling crash is heard afar, echoing in one vast volume of swelling tumult, amid the deathlike silence which prevails everywhere throughout the depths of these great woods. These "sticks," as they are then called, are next cut into lengths, and those that are not wanted for converting into scantlings are rolled together into a heap, so that at the appointed time when everything is dry enough fire may at one fell swoop complete the work of destruction. The stumps remain; the labour of stubbing up these would of course be enormous; they are therefore generally left for a period of years, varying from eight or ten to perhaps twenty or even thirty years, until the natural process of decay renders their removal easy. We have already mentioned that the trunks are generally so cut as to leave a convenient portion of the stems upstanding, and at the proper time advantage is taken of this, to encircle them with a chain and hook, to which a team of strong oxen are attached, when at one motion the last vestige of the former giants of the forest is uprooted from the ground. The number of years that must elapse before this can be accomplished will of course, as we have said, depend very much upon the nature and the size of the trees. The total expenses of clearing forest lands have been variously estimated, concerning which we append a few details extracted from a recent work. It must, however, be obvious that these matters must depend more or less upon local circumstances; but if we turn to a *new* country of heavy forest lands, such as British Columbia, the following information, gathered from settlers of experience, may be at once both interesting and useful:

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"To enclose 50 acres of land (with rail fence) takes $120 or £24. Clearing land from willows and alders costs $10 or £2 per acre, and these two trees always indicate good (though damp) land." But—"it takes quite $200 or £40 per acre to clear pine land, though the value of the timber would make some return for this outlay." *

This last item is however altogether dependant on circumstances, as unless near rivers, or other settlements, the value of timber is so trifling as to be almost inappreciable to early settlers, beyond its utility for construction purposes and fuel.

The wonderful dexterity with which some of the American woodsmen wield the axe must be seen to be believed. There was an immense amount of wood-cutting to be done, for instance, to enable the surveyors to fix the exact boundary between British Columbia and the United States, which runs for an immense distance through almost impenetrable forests of the heaviest timber; and Mr. Lord, one of the officers employed on the British Commission, who had extensive opportunities of forming an accurate opinion upon this subject, tells us that "trees measuring eight and ten feet in diameter, counted by hundreds, were cut down by their axe-men, two men only at a tree, with a rapidity utterly astonishing—trees which no ordinary woodsman would fell in a day, were stretched upon the ground in less than an hour." † The axes used to be in all cases of the American wedge-shaped pattern, weighing about 8 lbs. and mounted with springy and somewhat curved hickory handles. Thus equipped Mr. Lord says,

* *Life and Labour in the Far West*, by W. Henry Barneby, 1884, p. 129.

† *At Home in the Wilderness*, by John Keast Lord, 3rd edition, 1876, p. 122.

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the skilful axe-man, who knows how to use his tools, can do nearly anything and everything, "and armed with his axe, a three inch auger, a couple of gimlets, and a knife, can build a log cabin, split shingles to roof it, make a fire place, door, latch, hinges and window" * without the use of a bit of ironwork; and of course, can also quickly construct carts, rafts, bridges, canoes, and many other things needed for progress through a wild country. Want of time and space however obliges us to cut short our observations upon these and similar details respecting life in the backwoods; we shall therefore now proceed to give a sketch of the general appearance of the great forests of the Temperate Zone, as we have seen them—which we trust may prove of interest to Europeans and others who have never had the privilege of visiting these grand scenes of natural beauty and vegetative power.

There can be no doubt that this can be better seen in North America than in any other part of the world; but we must begin by saying that, as a rule, most of the forest now to be seen to the eastward of the Rocky Mountains does not by any means generally fulfil popular expectations of the magnificence of the primeval forest. To see this in all its grandeur one must go to the Pacific coast, and visit the forests of California, Oregon, British Columbia, etc.

Of course, in saying so we do not mean to convey that there are not considerable stretches of exceedingly fine forest still to be found in Canada, New Brunswick, Maine, and elsewhere—we merely speak of the general aspect of the American woods now ordinarily met with

* *At Home in the Wilderness*, by John Keast Lord, 1876, p. 122.

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there, in which we should certainly say that what mainly impresses the traveller is not, as might be supposed, the gigantic size and girth of the trees, because in most localities within reach of the settlements the lumberer has been at work, and nearly all the best and most valuable timber has been cut; leaving behind an immense and luxuriant growth of comparatively small trees, growing into, and destroying one another, much as may be seen any day in a neglected plantation in Europe; while old trees of great size are only to be found here and there, at intervals, sometimes standing singly, and sometimes in clumps; their tops towering like giants above their more insignificant neighbours, which are generally found crowding closely in all round them.

The prevailing impression then, is at first somewhat disappointing, and the noble vistas, beneath the over-arching canopies of branches, which one naturally expects to see, are of comparatively rare occurrence.

What chiefly impresses the mind is the interminable extent, the silence, gloom, and solitude of these great woods, where the sounds of life are but seldom heard.

The song of the bird too, which enlivens our English groves, is silent, for the stillness of the American woods is but rarely broken by the voices of birds; upon this point the reports of travellers are practically unanimous.

The signs of animal life are also comparatively scarce; and it is quite possible for the sportsman to travel even for days, without getting a sight of a single head of game; the new-comer therefore is apt to conclude that this is because scarcely any birds or animals exist there: but this is to adopt a very erroneous view of

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the facts; for plenty of living creatures are there, but the difficulty is to find them. The tree growth and underwood is generally so thick that it is as a rule impracticable for a man on horseback to pass through the forest, except by the beaten trails, without the constant use of the axe to clear away obstructions; and this being so, of course the sportsman, even when on foot, is pretty well sure to betray his presence by a certain amount of noise, whereupon these timid and watchful creatures, whose ears are constantly on the alert to catch the faintest sound of approaching enemies, at once move off with stealthy tread, and without so much as moving a twig, to safer quarters elsewhere. No! The way to see game is *not* to keep constantly on the tramp, but to adopt *their* tactics —to watch, and wait, and listen, in well-chosen situations, at the hours when the game pass to and fro to water, etc. But we must refer the reader, for further information on this head, to our sections on hunting, shooting, etc.; where we trust, so far as it may be possible to convey the information in mere words, further details of interest and utility are to be met with.

Walking in the forest, the new-comer will, by the way, soon discover, is much more fatiguing than walking along a road; so that an occasional rest will by no means prove unwelcome; for what with having to lift the feet, so as to step over creepers and other small obstructions, and being constantly obliged to climb over fallen trees, or to stoop so as to pass under partially fallen ones or else make a long detour to pass round them: it will be found that eight or ten miles in the forest, measured in a straight line, are at least equal

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to double the distance upon a smooth hard road. There are also certain sections of the forest, which must be passed through occasionally, which may fairly claim to be almost impenetrable—these are densely wooded swamps, with a matted thicket of dwarf alders, willows, and shrubs, of a water-loving character—and areas which have been devastated by forest fires a few years previously, where there are not only the old stumps and fallen sticks to contend with, but also a thick growth of young trees and shrubs, which shoot up with almost magical rapidity in such places.

But the worst of all is a "windfall" or track, where a hurricane has passed through the forest, cutting at times a regular lane through the trees. These places may vary from a few yards to one or more miles across, in which nearly every tree is uprooted, and thrown down one on top of another in the wildest confusion. Sometimes spots of this kind are found which are absolutely, not merely figuratively speaking, impassable—that is to say it might take a man an hour to advance a hundred yards, by a process of severe gymnastic exercises, climbing over one tree, and creeping under another, while at intervals he may be forced to work his way along a slippery trunk twenty feet or more above the level of the ground, where a false step might entail serious consequences. But the chaos that prevails in such localities must be seen to be fully understood, for there are often trees by the hundred, piled one on the top of the other, whose interlaced branches and trunks form an "abatis" or rampart, through which neither man nor beast can pass, and you must go over them if you are to pass at all.

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Now all these places—swamps, young forests, and windfalls—are just the spots which form the fastnesses of the forest game; for in these dense thickets it would be manifestly impossible for a man to approach without being heard long before he could come near, and the extensive nature of some of them very often makes an attempt to drive them, by the aid of men or dogs, impracticable.

Game animals also almost always take care to have passes, known only to themselves, which exist in several directions, by which they can noiselessly retreat when suspicious of danger. In the swamps, however, which often contain numerous small lakes and pools, hidden deep in the recesses of the forest, excellent wild fowl shooting may frequently be had. Many of these spots are far removed from the habitations of man, and consequently seldom or never disturbed by the report of the fowler's gun; and are besides, frequently of an exceedingly extensive character, covering it may be many square miles of ground. The time to see one of these places at its best, is during the great spring and autumn migrations of wild fowl, which occur periodically in almost every part of the world. Extensive swamps, or areas of country whose surface is dotted over with numerous sheets of open water, often become at such times a regular sportman's Eden, where geese and ducks of many kinds, and indeed almost every sort of wild fowl, may be seen in countless thousands. The flight lines of these birds naturally follow the course of the principal water channels traversing the forest region, which act as guides to direct their course. The larger lakes in such localities are very generally connected with each other by rivers or streams, which

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often form chains of communication, so that boats can penetrate for immense distances through an otherwise almost impenetrable forest country. Such instances are numerous throughout the world, and often form the only means by which the communications of primitive man have been able to be maintained throughout great periods of time. As may be supposed therefore, there is likely to be no lack of good sport for the wild-fowl shooter or the fisherman in such places; though their enormous extent is often apt to militate somewhat against the making of heavy bags, except as we have said at certain seasons, when migrations are in progress.—At other times game becomes so scattered over the vast expanse, that it is very hard to find.

There is one thing, however, which we regret to say, forms a very serious drawback to what would otherwise probably be the sportsman's sense of perfect enjoyment—we mean THE FLIES.

The constant torment created by these insect pests, everywhere throughout the Great Forest Region of the Temperate Zone, must really be experienced in one's own proper person, before a man can fully realize the extent and virulence of this scourge. There are vast districts of wild country, which as we shall have occasion to show are rendered practically uninhabitable simply by the fly—the data which we have collected upon this subject, are however so voluminous that we shall be unable to do justice to it within the limits of the present work. This subject is one of great interest, and though many authors have alluded to it in a cursory way, so far as we can discover none have attempted to write upon it as a speciality.

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Nevertheless most of us have heard of "Beelzebub," the "father of evil," and curiously enough, on coming to look into the probable origin of this unpleasant gentleman, we find that he is no other than "The God of Flies"—("Baal,"—the well-known idol, and "Zebub"—Fly, in the Chaldean tongue)—as such he was worshipped at a very early period in some parts of the East; when we say "worshipped" we mean, in the sense in which "the bad god" of many savage races comes to be invoked, when it is conceived necessary to placate him in order to remove some grievous scourge from the land. We merely however refer to this circumstance now in order to give some idea of the widespread and serious nature of the evil which flies are capable of inflicting in various parts of the world, concerning which many curious historical facts can be related.

Fortunately for the sportsman, the best of the wildfowl shooting of which we have spoken, both in spring and autumn, comes on either too early or too late for the fly. The fly season, when insect pests become really troublesome, may be said to correspond with the appearance and fall of the leaf, and is at its worst during the period when grasses, reeds, ferns, etc., are growing rapidly. At this period of the year the woods are so dense, that the hunter can see but a very short distance in any direction. Sport is in consequence bad.

We shall now ask the reader to accompany us in spirit to the Pacific coast of North America, where we shall be able to introduce him to the beau ideal of American forest scenery, and to what, there can be no doubt, are incomparably the finest primeval forests on earth.

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or at all events in the temperate zone; for the reader will, we trust, doubtless clearly understand the vast difference which necessarily exists between the forest in the temperate, and in the tropical zones—both of which have their own special points of grandeur and beauty; and perhaps this is not a bad opportunity for saying a few words upon the contrast exhibited between these great regions of arborescent vegetation.

If we go to elegance, delicacy, and beauty of foliage, there can be no question that the tropical forest must be held to stand unrivalled. We have no such leaves in the temperate zone, for instance, as those of the palm or the banana; and for grace and beauty the palm must be adjudged the first place as queen among the trees of the earth.

Then again we have nothing in the temperate zone to compare to the giant lianas, and other creepers, which bind the trees of the tropical forests together, like strong cables: the honeysuckle and the ivy, though beautiful in their way, make but a poor show when compared with these marvellous creepers, many of which at certain seasons are, as we have shown, covered with masses of magnificent flowers, whose aroma scents the whole surrounding atmosphere; our flowering trees also, in the north, are few and far between—that is to say, all of them, of course, produce flowers, but they are mostly inconspicuous ones of green colour, that the unobservant man will probably never notice at all: whereas the floral beauties of some of the great flowering trees of tropical climes, once seen, can never be forgotten. We might instance the Bauhinias and Bombaceæ, * as conspicuous examples

* One of the most common and best-known of these is the Red

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among many others. On the other hand some of the flowering shrubs of temperate climates are the finest of all—as for instance the rhododendron and the gorse.

Also, as instances of the wonderful vegetative power of Nature, the exuberance of tropical growth is out of all proportion great, when compared with the slower growths of the temperate zone; the giant grasses, such as bamboos, some of them over a hundred feet high, are striking instances of this. Then as regards the arborescent vegetation itself, in the temperate zone our underwood generally consists of but a single growth of lesser trees or shrubs; whereas in the torrid zone, as we have not failed to point out in our section on the equatorial forest region, we often find tier above tier of different kinds of trees, extending in several distinct forests, from the giant trees of the highest growth down to within a short distance of the ground, which in its turn is often covered with a dense growth of herbaceous vegetation and foliage plants, to which in our dim climate, so far removed from the regions of the sun, we can show nothing to compare. It is therefore indisputable that in very many ways the wonders of the vegetable kingdom are exhibited in a much more striking degree in the torrid, than in the temperate zones.

And yet when all is said and done, we venture to think that the great forest region of the temperate zone can hold its own against any other upon the face of the earth.

In the first place as regards the size and value of the timber, tree for tree, from a commercial point of

Cotton Tree (*Bombax Malibaricum*) of which we have given some account in our first volume.

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view; after taking considerable pains to consider this question impartially, from every aspect, we feel bound to say that in our humble judgment, the trees of the temperate zone, as timber, are finer, more useful, and more valuable, *generally*, than those of the tropics —but time and space will only admit of reviewing this question very briefly.

British naval experiences in this matter seem to us conclusive, as in our dockyards immense pains and expenses have been taken, to give a fair trial to every kind of tree, and to obtain the very best timber that the world can produce. And now taking a few of the most valuable of the tropical trees: for instance the teak (*Tectona Grandis*), we find that this tree attains a height of 100 feet, with a circumference of 10 feet, and yields timber in the log up to 50 feet long and 30 inches square, in extreme cases. *

Then there is mahogany (*Swietenia*)—the largest kind, though perhaps not the best, from a cabinet-maker's point of view, is the Mexican mahogany, which yields legs up to 30 feet long and 4 feet square. † Also we may mention "Pyengadu," or Burmese Iron wood, giving logs of 30 inches square and of great length §—and the greenheart (*Nectandra Rodiæi*) found in Guinea, a valuable timber, perfectly straight, and producing logs up to 50 feet in length by 24 inches square. **

There we have what are probably the largest and finest examples of tropical timbers. We do not now

* *Timber and Timber Trees*, by Thomas Laslett, Timber Inspector to the Admiralty, 1875, p. 113.
† *Ibid.*, p. 177—78.
§ *Ibid.*, p. 129.
** *Ibid.*, p. 151.

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speak of the many and valuable cabinet-maker's woods, which are mostly of small size, and prized mainly for the beauty of their colour and grain—nor yet of dye woods, nor medicinal products—we simply regard the tropical trees as timber, and what are they compared to the timber trees of the temperate zone? We shall furnish the reader with some technical details upon this head presently.

But there is another matter which we can by no means pass over in silence, and that is the general tendency of tropical woods to crack and shrink, and to develop what is technically known as "heart-shake" and "star-shake"—which greatly detracts from the value of their timber, though it must be confessed that all timber is more or less liable to blemishes of this kind, but it is exhibited in greater degree in tropical than in other woods.

Let us take a single instance, that of teak—perhaps the most valuable of all timbers for certain purposes. Mr. Laslett, a high authority on such matters, states that—

"It is characteristic of Rangoon Teak" (one of the most valuable kinds) "to be shaky at the centre, there being beside the heart-shake, which is common more or less to teak timber, a close fine star-shake, which is seriously detrimental to its value." *—"Many of the logs" (he continues) "cannot on this account be converted into boards or planks, without incurring a very considerable loss." †

And so we might go on to show how this is the case with nearly all tropical timbers, in a greater degree than is met with in those of the temperate

* *Timber and Timber Trees*, by Thos. Laslett, 1875, p. 117.

† *Ibid.*, p. 122.

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zone. Why—it is perhaps beyond our province to enquire here; but it must be manifest that the generally vastly more rapid habit of growth of tropical trees, the absence of the prolonged winter's rest, and the consequently larger amount of moisture contained in them, is sufficient to account for a great deal of this unfortunate peculiarity. Consequently the split, in drying.

Then as regards the commercial value of forest products, it is hardly necessary to add that the trade done in pine and other northern timber trees is out of all proportion greater than that done in tropical woods. In the building trade for example, the timber used may be said to be almost exclusively the product of coniferous trees—the use of tropical woods being nearly altogether confined to articles of furniture.

Now, if we wish to see the pine forest in its grandest aspect, we shall, as we have said, find it in all its magnificence upon the Pacific slopes of North America. In the tropical forest the mind is confused and overwhelmed by the vast number and variety of the surrounding forms, but it is rare there to see whole districts of country covered with a single variety of tree, such as predominates in many parts of the northern forests. There are however of course some exceptions to this rule, as for instance the evergreen Sâl forests (*Shorea Robusta*) of Central India.

In the great forests of North Western America, for instance, considerable areas may be found where there is very little mixture in the species of trees, and where every tree is for the most part faultless in its symmetry, with hardly a small specimen to be seen amongst them, each of their trunks rising like an immense natural column for nearly a hundred feet without a branch; and

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then the dense canopy of pine boughs interlacing overhead, so far excludes the light that it keeps the ground below in such situations pretty well clear of vegetation; so that vistas of Nature's architecture may frequently be seen, whose solemn simplicity and majesty almost exactly represents the aisle of some great cathedral. The whole effect in its spacious grandeur, its air of antiquity, its eternal tranquillity and silence is that of some enormous temple, dedicated to the worship of the Supreme Being. The forest floor in some of these places consists of an accumulation of pine needles, the deposit of centuries, which has annually fallen from the crowns of the monarchs of the woods above; upon which the human foot leaves its impress almost as upon the mould of a garden bed, while at the same time it is as soft and springy as a well-stuffed sofa, and almost as slippery as so much ice: this the traveller will very soon discover, should the ground beneath his feet have a rapid slope.

Indeed there is nothing more difficult to walk upon than a steep place carpeted with pine needles—the feet fly from under a man exactly as if he were upon ice.

When we say that such spots as these are to be found, the reader, we trust, will not misunderstand us, and suppose that such is the general aspect of these forests; for the greater part of them is usually filled with underwood of some kind, especially when there is a break in the canopy of foliage overhead; the ground is then often covered with a magnificent growth of ferns, sometimes as high as or higher than a man's head, very often of a variety resembling our well-known male fern; or at other places it is obstructed by fallen timber, or underwood of different kinds, which interrupts

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the view and so spoils the wonderfully majestic and solemn scene we have described above—and yet vistas of this kind, of marvellous beauty, are frequently to be witnessed, from the top of a declivity or rocky eminence, or other point of vantage, where the spectator can see down a ravine or stretch of forest extending below, where the eye ranges *above* the underwood, yet beneath the great canopy of forest which towers high above all. The contrast between the tender green of the ferns and undergrowth, and the dark sprays of the pines above, is often exceedingly beautiful, and sometimes a position of this kind, if the wind is favourable, is not a bad place for observing the movements of game, and perhaps getting a shot at deer or other creatures. The neighbourhood of lakes or streams is however perhaps generally the best for the gunner; and some of the sheets of water nestling in the bosom of the forest, with the amphitheatre of dark pines reflected in their glassy surface, are often scenes of exquitise beauty and tranquil repose. Not unfrequently small companies of water birds may be seen floating on their surface, and on a still evening the plaintive cry of the loon, or the cooing of wild pigeons is heard; while the rises of many fish testify to the numerous shoals of the finny tribe which their waters enclose.

But soon the lengthening shadows of the evening warn us that the labour of the day is drawing to a close, and that we must needs prepare for the night, wherein the Scripture reminds us that "no man can work." * These figurative words of the Divine Spirit come home with special force to the traveller in the pathless forest regions, where moving about by night

* *St. John*, IX. 4.

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is generally entirely impossible: as in the heavy forest there is generally a sort of subdued light even in the day-time, and the night is therefore pitch-dark.

Consequently, where the night closes in, there the wayfarer must remain till daylight returns; the brief preparations are therefore quickly made—and if needs be a small space is cleared of obstructions; a sufficient supply of dry wood is collected to last the night, and sprays of deliciously scented pine branch tops (usually termed "browse") are arranged to form an elastic couch, upon which the traveller generally finds there is no difficulty in obtaining the most delightful repose—so much so, that in America, as we have mentioned in our opening pages, many men who are over-worked and harassed by the continual turmoil of city life, make it a practice every year to take a few weeks well-earned rest, encamped in the tranquil recesses of the woods—"Locus quietis et tranquilitatis plenissimus." * Here, far from the cares and worries of the great world, in an atmosphere laden with the balsamic incense of the pine trees, should the weather be propitious, many men find that they can obtain that complete rest for the nervous system which is not to be had anywhere else. Even consumptive patients have sometimes tried it, with marked benefit to their condition.

A night camp in the forest, in some sheltered nook beneath the shade of these grand old trees, is an experience which rarely fails to leave a deep and lasting impression upon the mind; and passages culled from the works of many travellers show that almost all of them have felt and recognised its influence.

* Cicero, *de Oratore*, i,—1.

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The intense darkness, the deathlike stillness, and the absolute isolation from the outer world, all combine to exert a powerful effect upon the imagination. There are places in the forests of the great North West, where it is possible to march straight ahead, even for weeks, without coming to an end of the woods. In every direction, there is still forest—nothing but forest—and after leaving the settlements, and penetrating some distance into the woods, a man is lost to the world, unless he knows how to make his way out again. His friends might as well seek for a needle in a haystack, and an army might search for him in vain—the sense of isolation is therefore complete, more so even than at sea. Nevertheless, when a man has confidence in himself, and in the fidelity of his companions and guides, these things do not break in upon his rest, nor diminish aught from his keen enjoyment of the sylvan beauties of Nature's wild domain. And settled comfortably to rest for the night, beneath her verdant roof, wonderfully picturesque are the effects sometimes to be witnessed; when as the camp fire burns up brilliantly, he gazes aloft, and sees the overhanging canopy of closely intertwining branches, glistening like some richly decorated ceiling, cast as in a mass of molten silver, suspended at an immense height above. This is produced by the glaucous foliage of many of the silver firs, whose leaves, on their lower side, are of a beautiful silvery white, particularly striking when seen illuminated by the firelight at night. On turning up a spray of the picea nobilis, picea nordmanniana, and many other species, by day, the reader will easily see for himself that this is so.

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The ruddy glow of light also, throws the tall columnar trunks of the neighbouring trees, with their brown and cinnamon coloured barks, and pendant wreaths of silver-grey moss into bold relief; the shadowy arcades of the forest, with its amphitheatre of surrounding trunks being dimly seen beyond, until the circle of unfathomable darkness shuts out the view.

The floor of pine needles, upon which the traveller's couch is generally spread, is also worthy of a moment's thought—for it is at once a nursery and a tomb. In nothing, to our mind, is the greatness of Nature more strikingly apparent, than in this wonderful uprising of exuberant masses of animated life out of the products of decay and death, which we see to be everywhere the law of life.

In one of the finest passages in the Koran, * as we have pointed out in our section on "The Desert Zone," the Moslem prophet has laid peculiar stress upon this curious and impressive fact; and nowhere can it be witnessed in a more striking degree than in the primeval woods; for beneath the traveller's feet, undisturbed throughout the ages, lie the dust of many generations (compared to which the Catacombs of Egypt are as a thing of naught), of myriads of the forest giants, from whose decay the present woods arose. Trees, as we know, have like ourselves their allotted span of life, it may be three hundred or four hundred years, or it may be a thousand years—and what does it matter, in the vastness of an eternal past? But in the end they fall and rot and are succeeded by others; for it is evident that in these great woods forest has succeeded forest, perhaps through a greater number of centuries than it was

* *El Koran* (of Mahomet), Sura vi., 96.

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till recently the fashion to suppose that the earth's age was to be counted in years.

The accumulations of uncounted ages have thus gradually carpeted the surface of the earth over thousands of square miles, with a covering of vegetable mould, often many feet in thickness; indeed when in the State of Tennessee, we were assured that in some of the bottoms near the Mississippi, this had actually been found to consist of as much as *fourteen feet deep* of solid leaf mould and other decayed vegetable matter.

It is curious to observe some of the prostrate trunks of these great trees, wich may be seen in numbers, in every stage of decay. Some have recently fallen, and their bleaching stems still form the finest kind of seasoned timber. Others are overgrown with a close covering of lichens, mosses, and ferns, marking the progress of decay; and though the outward form continues in many instances to be preserved with little change, the pressure of a human foot, of a man climbering across, is occasionally enough to cause the giant limbs of the defunct forest monarch to crush and crumble into dust. No easy task it is sometimes to make one's way across some of these great trunks, whose diameter is often higher than a man's head. Then again we come across others, where some great tree has long since fallen, which has perhaps mouldered so completely into decay, that a low, soft, moss-grown ridge, like a long sepulchral mound, is all that remains to attest the fact of its former existence. Here the parent stem has actually returned to earth, and is in a condition to form the cradle of new forms of life.

This adaptation of decaying substances to form the support of future rotations of living organisms is surely

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one of the most wonderful phenomena of Nature, and furnishes us with a clue to one of the means by which life in its various forms is perpetuated upon our planet.

Scientifically speaking this process of decay in timber may be said to commence from the moment that its vegetative existence comes to a close, just as it does in the dead bodies of animals; and in both cases, the destruction of the tissues is due to a species of slow combustion whereby they are chemically consumed in periods of time which vary in length. In the case of timber, though decay may be retarded by protecting it from the action of the atmosphere, and from damp, still the ultimate issue, as in the case of animal remains, is certain; as according to Mr. Grantham, C.E., and others, the oxygen, which during vegetation is held in harmless combination, begins the work of destruction from the time that vegetative life ceases. Carbonic acid is evolved, and as the deterioration of the woody fibre proceeds, the timber loses its flexibility and strength, and finally becomes carbonized. This process, it has been pointed out by Mr. Kuhlman, is hastened by the driving of iron nails, etc., into woodwork, which act as carriers for introducing oxygen into the substance of the timber. It is probably to this latter fact that the rapid decay of the hulls of "composite" ships, or vessels constructed partly of iron and partly of wood, was frequently due.* In what is known as "dry-rot" in the timbers of ships and houses, the process of slow combustion, by which the wood is eventually consumed, is perhaps better seen than in any other form of decay. The thickness of the timber, in these cases, does not

* See Stevens on *The Stowage of Ships and their Cargoes*, 4th edition, 1867, pp. 612 to 614.

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increase its durability, in proportion to the size of the scantlings; and an unsound portion seems to have the property of infecting the surrounding timbers with its own decay. Thus the ravages of dry-rot spread rapidly in every direction.

The observer, in the course of a few hours' journey through the forest, may thus witness the process of conversion, as carried on in the great chemical laboratory of Nature, proceeding in every stage of its progress; and the practical chemist who has made these matters his study would have no difficulty in demonstrating that this is effected without one particle of waste.

Indeed it may be accepted as an axiom of chemical science, that everything is unceasingly undergoing a process of *change*, but that nothing is *lost*. It is true that the apparent residuum is often small when compared with the magnitude of the mass that is acted upon; but that makes no difference in a scientific point of view; it is merely so, because many of the products are given off in an impalpable form, such for instance as gases of various kinds, which in their turn are absorbed and assimilated by living organisms; and they thus become under different conditions integral portions of living plants and animals. It would, however, obviously be out of place to attempt any technical description of the processes of decomposition and reconstruction in these pages: processes which, as we know, are continually in operation throughout the whole realm of created nature—even the living plant and animal is not exempt from this universal law of life. Physiologists for instance have even gone so far as to calculate the approximate term of years which it takes to change

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and reconstitute every part of the frame of the living man. Thus the man we know at fifty, is not the same man, in his corporeal body, as the man we remember at twenty or thirty; though the same soul inhabits the bodily frame, its earthly tenement has been so often repaired, renewed, and gradually reconstituted from time to time, in its various parts, that it is clothed in what is in truth *a different* body. And even as to the mind (the soul that is), we are all of us conscious of the great changes that are at work there: the whole characters and opinions of some men have undergone not one, but perhaps several consecutive changes, each so marked in its intensity as to make the individual "quite another man," as it is sometimes popularly said of him. Incessant change may therefore be regarded as a constant law pervading the whole economy of Nature. There seems to be no exception to this rule, so that the flight of time itself is not more steady in its march than that of the changes which everywhere accompany it. In a great forest however these facts are brought more clearly into view, than in any than region—and therefore we have specially called attention to them here.

A most curious study also is the infinite number of varieties of the forms of life, both animal and vegetable, which exist upon the decaying substances of a great forest. These, of course, belong almost exclusively to the lower forms of life, and though they are to be found everywhere, they seem to be in greater numbers, and their operations are more distinctly visible in the forest than elsewhere.

This again would involve us in a really interminable range of enquiry, did we venture to go further than

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merely to draw attention to the fact of its existence. The observant man however cannot go far through a great forest without being struck with the vast swarms of insect life which it contains; every living tree is a museum of entomological research—there is scarcely a leaf, or a portion of bark, that does not contain its own special form of parasite which feeds upon its juices or its substance—and does it begin to decay? or does it fall and die? Why then, each of those periods of change breeds its multitudes, which feed upon decaying or dead wood. Even the solid heart of the timber itself becomes honey-combed by various kinds of borers, which finally reduce it to impalpable touch-wood, till at last the final stage of disintegration is reached which we have already noticed a few pages back.

Then as regards the vegetable forms of parasitic life—How protean is their abundance, their variety, and their ubiquity! Countless varieties of lichens and mosses cover the limbs and trunks of every living tree, the surface of every rock or bank of earth. The smoothest and hardest stone for instance that can be placed there, does not long remain exempt from some form of parasitic growth. Shortly some little yellowish or greenish discoloration becomes apparent on portions of its surface, marking the impress of the wearing finger of time; and showing by its existence that even there the process of decomposition and disintegration has already begun, to whose unceasing operation we have already referred.

Then again every stage of decay is marked by its own special form of growth—first the lichen, then the fungus, the moss, the fern, and finally the new genera-

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tion of trees itself, all successively feeding upon, and destroying, the remains of the fallen; till at length they are entirely incorporated with the soil from which they formerly drew their life. Thus does dust return to dust, from whence it first arose, both in the vegetable and in the animal creation.

Lastly, as regards the soil itself, the surface as we know is often covered with a verdant carpet of herbaceous vegetation; and beneath it are various forms of fungoid growths; a curious one, dear to the palate of the gourmand, for instance, is the truffle, which inhabits the soil of many ancient woods—especially under beech or chestnut trees.

Then, of course, still further down, and mostly out of sight, is the infinite network of roots whereby the the trees and plants draw their nourishment from the soil, varying in size from the thickness of a man's body to the fineness of a human hair. Not less numerous, or hardly less remarkable than the vegetation is the infinite variety of insect life which inhabits the surface and whole thickness of the upper crust of the soil, or humus. Let anyone consider the vast legions and countless varieties of insect life which are to be seen both upon and above the surface of the ground. What pen could describe them? Or who could form even an approximate idea of their numbers?

The multitudes of ants for example—to take only one kind of insect—which fill some sections of the pine forests, in places where the winter is often most rigorous, and where the snow must cover them over many feet deep for several months in winter—are marvellous to behold. These industrious little creatures collect nests of pine needles, of which they construct

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large mounds, which are sometimes found every few yards apart all over the wood; each of which if stirred up with a stick, is found to be a living mass of ants, which emit a strong scent like aromatic vinegar supposed to proceed from certain combinations of formic acid produced by these insects. The ground in such localities is in every direction seamed with their runs, along each of which myriads of these little creatures may be seen hurrying to and fro, busily intent upon laying up stores for the coming winter.

Then as regards winged insect life—for we have only space to allude to these matters in the briefest possible way—it is equally numerous, and in many forests constitutes, as we have said, a real plague of the first magnitude, rendering certain sections of country quite uninhabitable in "fly time." One must have seen and experienced its torment, in a really bad fly-stricken district, to realize the full extent of this terrible infliction. We allude now to the gnat, mosquito, black, and sand fly tribe, and other winged pests, which attack man.

These insects, however, must not be regarded as an invariable concomitant of the forest region—there are some sections of the forest which are almost free from them—and there are places both upon the open treeless plains, and even in the arctic zone, where they are sometimes found to be almost worse than in the forest itself.

Alluvial flats and swampy lands, we need hardly say, are as a rule more infested by them than other places; but on the other hand there are certain sorts of flies which are worse on high breezy downs of a dry sandy nature, than in any other locality—so

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that it is never possible to be quite sure beforehand where the fly will be bad and where it will not. We do not feel justified in attempting to lay down any general rule on this matter, for experience has long since taught us the impossibility of doing so; we shall therefore merely mention that in the course of our wanderings in many lands we have generally remarked, that wherever the waters are muddy and discoloured, there as a rule flies will be bad. Whereas, those favoured districts where flies are *not* troublesome are generally regions where the waters are of crystal clearness; where the lands are irrigated by swiftly flowing streams; and where the soil is of a somewhat dry and gravelly or rocky nature—it is not necessarily barren land; we have seen flies very bad on exceedingly barren land; and we have seen flies cease from troubling in sections of forest where the magnificent timber showed that the soil was rich and productive.

The most troublesome of these insect pests, such as mosquitoes, which generally seem to hover near the surface of the ground, are no doubt a certain sign of a more or less malarious influence. Wherever, for instance, we find mosquitoes bad, in tropical regions, there we may be certain malaria exists. Whereas, where they are conspicuous by their absence, we may regard it as a district which is probably healthy. So also in forests of the temperate zone, we may, we believe, even there set down a bad, fly-stricken district as probably infected by some modified form of malarial germs, though these may not always be strong enough to affect the human system with disease of a distinctly malarious type. As regards this, we know that malaria *does* sometimes extend far up into temperate latidudes.

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History teaches us, for instance, that some centuries back, when England was more or less a forest country, and before it had been generally drained and cultivated, fever and ague was then very prevalent. King James I. died of it, and so did Oliver Cromwell;* and the ancient records prove that in certain parts of the country it was sometimes present in a very severe and fatal form.† And it is so now in many parts of the North American newly settled lands, though, of course, its ravages are largely controlled since the discovery of quinine, so that "the chills" are now not near so much dreaded as they formerly were. As a rule, however, the forest region in this part of the world, especially the pine forest, is free from malarial disease, or at least from diseases which we can say are of undoubted malarial origin; but attacks of diseases of various kinds, many of which may be suspected to arise from malaria, are very apt to appear in all recently settled countries, as soon as the forest is cut down and the soil turned up. The history of the early settlements in America and elsewhere is full of experiences which place this fact beyond controversy.

But besides those tormenting insect pests, some of whom live on malarial germs, whose bites are so irritating, and which, as we have pointed out, mostly keep within a short distance of the ground, there are the winged multitudes of flying creatures, most of whom are harmless to man, which inhabit the higher regions of the tree

* So also Queen Mary ('Bloody Mary'), we can have no doubt after considering the circumstances of her death, was cut off by an illness resulting from, or at any rate complicated by, malarial disease.

† *Dictionary of Medicine*, by Richard Quain, F.R.S., Vol. ii., p. 915 (Article on "Malaria"). See also Tanner's *Practice of Medicine*, 5th edition, p. 173 (Article "Intermittent Fever").

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tops. Upon a still day, during the summer and autumn season, the traveller through many sections of the forest will frequently be made conscious that the atmosphere is literally filled with countless legions of these tiny creatures; the constant, deep, sonorous murmur of whose myriad wings sounds above his head like the swarming of some gigantic hive of bees. On looking up, however, where a break in the foliage occurs, there is seldom anything to be seen; and yet the sound seems to come from everywhere in the expanse overhead; and it is probable that these vast multitudes of flying things live partly on each other, and partly upon a species of manna that is secreted by the leaves of many trees at certain seasons of the year. It sounds, as we have said, like the swarming of bees—but bees, so far as we are aware, though very numerous in some parts of the country, more generally affect the outskirts of the great forest, near prairie lands or mountainous barrens covered with heather and other flowering plants, than the depths of the heavy forests. The usual place of their swarming is in the cavity of some hollow tree, where immense masses of honey and combs are sometimes found. The discovery of these bee-trees is a regular trade in parts of North America, which is followed by professional bee-hunters, who catch a bee, and fixing a small feather or bit of straw to it, liberate the captive, and watch its progress through the air, as it passes straight towards the parent hive; the bee-hunter follows in the same direction, and presently tries a similar experiment on another bee, until at length he succeeds in tracing one to the opening of some hollow tree, which is then felled—the concussion of the fall often splitting open the rotten

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trunk, and disclosing the hidden treasures of sweetly scented honey enclosed within; the unfortunate bees, stunned by the sudden catastrophe, are said seldom to make any serious resistance to the removal of their stores, if this is done immediately before they have time to recover from the shock—though to speak frankly, we should much prefer to take this fact upon the authority of others than to try the experiment in our own person. Attacks of bees sometimes result in very dangerous consequences to the person assailed; though of course with proper veils, thick gauntlets, and other precautions, a man ought to be able to efficiently protect himself.

The honey bee, we may remind the reader, does not appear to have been indigenous to America, but was originally brought over from Europe by the white colonists, at an early period in the history of the "Plantation." Like many other living creatures and plants then introduced, they took kindly to their new home, and multiplied exceedingly in a wild state, and now, so far as we can learn, appear to have established themselves almost all over the regions where climate and circumstances admit of their doing so; they have in consequence as we have before remarked come to be regarded by the red man, whose acute observation nothing can escape, as "The White Man's Fly;" and though the Indians will eat its honey whenever they can get it, the honey bee is nevertheless regarded by them with a certain amount of superstitious dread, as "bad medicine," or a thing of evil omen. With wonder and alarm they saw the white man's fly quickly spread itself all over the land, and occupy it in such numbers as to render all idea of its ever becoming extinct hopeless, even were it

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desirable; and under these circumstances therefore it was regarded as an omen of the eventual conquest of the country by the white stranger. No one can deny that in this instance at all events, the medicine man's prophecy has turned out correct, for wherever the bee has gone the white man has followed. And remarkable it is, that almost the self-same superstition, if we may call it so, has taken fast hold of the Maori, or aboriginal native of New Zealand. That this should occur thousands of miles away in distant lands, among tribes of totally different race and language; and that what is practically the same figurative idea should spontaneously lay hold of the native mind, both in America and in New Zealand, is a most curious coincidence. Speaking of the probable future of his race, an old New Zealand native is said to have philosophically remarked: "The white man's rat has driven away our rat—The European fly drives away our fly—His clover kills our grass—and so will the Maoris disappear before the white man himself." * See how these little facts in natural history are at once seized upon, and applied to the practical illustration of every-day life, by these widely-separated native tribes! This gives us a good illustration of the peculiar cast of thought which exists among wild men almost everywhere, and shows that their acute powers of observation, and attentive study of the great Book of Nature, might well put to shame the more cultivated intellect of the white man.

Few of those who study the ways of Nature will be

* *Darwin and after Darwin*, by Geo. J. Romanes, F.R.S., p. 286 (This is a scientific work on the origin and descent of species and the struggle for existence).

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disposed to deny that it is a regrettable feature in our modern civilization that men are so wrapped up in business or pleasure, as to be for the most part indifferent to anything else; the perpetually increasing competition in the struggle for existence which is always going on, being often more than sufficient to occupy their whole time and energies: until physical exhaustion demands, during their leisure moments, rest from all mental exertion.

As regards the question of tree life itself, it is a large subject, on which volumes have been written without exhausting the innumerable features worthy of note, connected with so great a branch of scientific research. We propose therefore to confine our observations on this head to a general description, including a brief notice of a few of the principal kinds of trees, remarkable either for their gigantic size, beauty, or value, from a commercial point of view; a short description of which, we think, will serve to convey a better idea than anything else, of the impressive and—once seen—never-to-be-forgotten grandeur of the great forest region of the temperate zone in its finest aspects.

It is a theme not easy to do justice to, and may be held to be one which, while it affords boundless scope for the descriptive powers of writers, both of fact and fiction, will still surpass the finest efforts of any of them.

Perhaps also we ought to preface our remarks by saying that if in our efforts to portray the splendour of forest scenery we appear to devote undue attention to the great woods of North America—it is because the forest region there is better known than that of any other great wilderness of tree life in any other part of the world, and because a much fuller and better

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description has been given of it by the pens of many writers, of different nations and languages, than of any similar region elsewhere.

One hundred and thirty, or one hundred and forty years ago, when the great struggle which was then going on between Great Britain and France for dominion over North America first attracted the general attention of the civilized world to those regions, nearly the whole seaboard of that great continent appeared to be one vast forest region, both on its Atlantic and also to a great extent upon its Pacific coasts; and how far the forest extended inland, or whether or not it stretched in one unbroken expanse from sea to sea, was practically unknown. There had been vague rumours from Spanish and French sources of a great plains country to the westward of the Mississippi, but nothing definite was known about it, for the records of the early discoveries by the Jesuit missionaries were generally kept a close secret among the archives of the government offices at Paris and Madrid; indeed it is only within quite recent years that access has been obtained to them at all.

Mr. Parkman tells us that at the time of the British conquest of Canada, in 1760, throughout all that country and the United States, except where the woods had been actually cleared away by the settlers—"one vast continuous forest overshadowed the fertile soil, covering the land as grass covers a garden lawn, burying mountains and valleys in verdure."*

At the opening of the revolutionary war in 1775, Mr. Roosevelt, in describing the forests in the revolted provinces, says that:

* *The Conspiracy of Pontiac*, by Francis Parkman, 1885, Vol. i., p. 147.

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"the underbush grew dense and rank between the tall trees, making a cover so thick that in many places it was impenetrable; and nowhere could the eye see as far as a bow could carry. No horse could penetrate it, save by following the game trails or paths chopped with the axe. Here and there it was broken by a rare hillside glade or meadow, but elsewhere a man might travel for weeks in a perpetual twilight, the interlacing twigs forming a dark canopy above his head." *

At that time narrow trails such as are here described, led through the recesses of the forest, from one clearing to another, and often formed the only channels of communication with the outer world.

When the darkness of the night closed in upon them, these isolated spots, which were often separated from each other by several days' journey, were as much cut off from all external help and intercourse with the world, as if they had been situated in mid ocean; all moving about by night, within the shadow of the trees, being impossible. But in most places it was the rivers which formed "the liquid highways of the wilderness" †—and it was by their means that all the main lines of communication were kept up throughout the country. From time immemorial the Red Indian forest tribes had used them as such.

It is impossible to conceive anything more perfect than the beauty and romantic nature of the scenery along the course of some of these streams, which wind like a silver thread through the pathless depths of the woods, whose overhanging branches often dip into the current, and whose dark masses of pines and other trees,

* *The Winning of the West*, by Theodore Roosevelt, 1889, Vol. i., p. 80

† *The Conspiracy of Pontiac*, by Francis Parkman, 1885, Vol. i., p. 155.

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hedge them in like a wall on either side; and as an instance of the luxuriant wealth and bounty which Nature used sometimes to exhibit, in the early colonial days, before the wondering eyes of travellers, as they floated along the stream of some of the great rivers which flowed through the American forest, we may just quote a description given by the explorer Gist, of his journey along the valley of the Ohio in 1751:

"The land beyond the Scioto, except the first twenty miles, is rich and level—bearing walnut trees of huge size, the maple, the wild cherry, and the ash; full of little streams and rivulets; variegated by beautiful natural prairies, covered with wild rye, blue grass, and white clover. Turkeys abounded, and deer and elks, and most sorts of game; of buffalos thirty or forty were frequently seen feeding in one meadow." *

It is clear from the park-like character of this country, and from the fact that buffalos included it within their feeding grounds, that the explorer was then probably approaching the limits of the forest region at that point; and although there is no such sportsman's paradise to be met with in America nowadays, there are still to be found many equally perfect scenes of placid beauty, fresh from Nature's hand, where the lover of the angle may find ample occupation for the exercise of his skill, and be rewarded by sport of exceptional excellence. Also perhaps, it may be as well to mention, that the above passage extracted from Gist's Journal, † is important, as disproving the allegation sometimes made, that the range of the buffalo never passed far, if at all, to the eastward of the Mississippi river.

The numerous tribes of forest Indians who at that

* *History of the United States*, by Geo. Bancroft, 18th edition, Boston, 1862, vol. iv, ch. iii, p. 78, "The Exploration of Ohio."

† *Gist's Journal* in Pownall's Appendix, p. ii. (Quoted by Bancroft).

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time occupied the country, used to skim the surface of all these waters in their birch bark canoes, whose model continues, even to our own day, to be regarded as the perfection of combined strength, lightness, and grace of construction.

These canoes are manufactured from the bark of a noble species of birch, peculiar to the American forests, known as the "canoe" or "paper" birch (*Betula Papyracea*), which grows to an immense size, and it is said "attains to the height of 70 feet, and is often three feet in diameter." * Mr. James Brown, a high authority on questions of forestry, states that specimens occasionally grow to dimensions considerably greater than the above, which may be regarded as the more usual size of fine trees of this description of birch; for he states that he has found specimens of the canoe birch in Canada, which are "not infrequently from 90 to 100 feet in height, with a diameter exceeding 4 feet 6 inches." † But in general, he admits, it does not exceed the dimensions given by Captain Levinge. Mr. Brown also states that the canoe birch differs from the common birch, in that it never grows on soils of a wet or sour character, such as the other varieties are usually found on, but upon land of an altogether better and drier description, in which localities alone it is capable of flourishing. §

To the Indian, the explorer, and the settler, the birch tree stands pre-eminent, if not as *the most* valuable, at any rate as one of the most valuable of all trees—

* *Echoes from the Backwoods*, by Captain R. G. A. Levinge, 1849, vol. i., p. 116.

† *The Forester*, by James Brown, 4th edit., London, 1871, p. 239.

§ *Ibid.*, p. 239.

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because of the immense number of useful purposes to which its bark can be applied. Nearly all the household utensils employed by the Indians were made of it; it formed a covering for the roofs of their wigwams; and when on the march, a roll of birch bark served as a light and waterproof covering to shield them from the rains. Beautiful boxes and other ornamental articles can also be manufactured from it. Lastly, pieces of dry birch bark make the best of all kindling for fires; and a small tightly twisted roll makes an excellent extemporized torch, should a brilliant light be required for a short time; when once fairly alight it is not easily blown out by wind, but burns with a clear bright flame, emitting a smoke which has a delicious aromatic fragrance. In Russia an oil is also made from birch bark, which is alleged, when rubbed upon the skin, to be a sovereign remedy against mosquitoes. The scent of "Russian leather" is due to the same source.

The birch tree, of which there are numerous varieties, is found almost everywhere throughout the colder portions of the temperate zone, upon alluvial flats, and along the borders of lakes and rivers; and with the exception perhaps of certain kinds of dwarf willows, its range extends further to the northwards than that of any other sort of tree. In the neighbourhood of the arctic circle however, in common with all forms of arborescent growths, it gradually becomes dwarfed in size, and large specimens are no longer seen; but its beauty and elegance of form and colour, in far northern situations, can hardly fail to make a lasting impression on the traveller's recollection; for where the winters become of arctic severity, the intensely brilliant colours

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of the external layers of its bark become most striking, the weatherside of each tree appearing as if coated by a covering of the purest driven snow, while the mottled surface of the remaining portions are flecked with every conceivable shade of grey, brown, and black, all of the most brilliant hues of their kind, and often appear highly polished, as if by some artificial process.

As regards the manufacture of birch bark canoes, they are made by almost all the northern forest tribes to the eastwards of the Rocky Mountains, but the canoes of the Chippeways have generally been regarded as the *ne plus ultra* of artistic design, and Catlin in his standard work on the red man (though his largest experiences were among the prairie Indians) gives it as his opinion that:

"the Chippeway canoe is perhaps the most beautiful and lightest model of all the water crafts that ever were invented" —and he states that "they are generally made complete with the rind of one tree" (the *Betula Papyracea*, as we have before observed) "and so ingeniously shaped and sewed together, with the roots of the tamarack, that they are water-tight, and ride upon the waters as light as a cork." *

According to Captain Levinge, the bark is best obtained in the winter months, and a fire is applied to make the tree peel freely. † As regards this, we are in some doubt, as trees are known to peel more freely when the sap is up than at any other time; and Catlin says it is removed from the trees by the Indians in summer. § But however that may be, there can be

* *The North American Indians*, by George Catlin; Edition of 1857, Vol. ii., p. 138.

† *Echoes from the Backwoods*, by Captain R. G. A. Levinge, 1849, Vol. i., p. 116.

§ *Ibid.*, Catlin's Indians, Vol. ii.

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no doubt that the birch bark canoe is, after their gun and blanket, by far the most valuable article among the forest Indians' effects; and Captain Levinge assures us that the growth of every canoe birch sapling of any promise is jealously watched over by them, as trees sufficiently clean and free from knots to make canoes are scarce and difficult to find. The bark which forms the outer shell of the canoe having been got into shape, the gunwales and thwarts are formed of strips of ash or other hard wood, and the delicately formed ribs and flooring are made of white cedar or pine, while the whole is sewed together with fibrous roots carefully prepared for the purpose, and the seams are coated, so as to be perfectly watertight, with the gum of the spruce or balsam firs, which is plentifully found throughout the great pine forests. *

These beautiful boats are far from being as frail as they look, and Captain Campbell Hardie says that a canoe scarcely exceeding 60 lbs. weight, will carry four persons and a proportionate quantity of luggage. † While Captain Levinge considers that the average weight of the larger canoes from sixteen to twenty-one feet in length, is about 120 lbs., and in such a one he assures us, he has often see an Indian family, fifteen or sixteen in number, stowed away, with all their goods and chattels; and, "loaded in this way, to the very water's edge," he says, "they will fearlessly hoist an old blanket by way of a lug sail, and carry on when a tremendous sea is running." § In crossing some of

* See *Echoes from the Backwoods*, by Captain R. G. A Levinge, 1849, Vol i., pp. 117, 118; and Captain Campbell Hardie's *Forest Life in Arcadia*, 1869, pp. 295—6.

† *Forest Life in Arcadia*, by Captain Campbell Hardie, 1869, p. 295.

§ *Echoes from the Backwoods*, by Captain R. G. A. Levinge, 1849, Vol. i., p. 118.

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the larger lakes with which many parts of the country abound, the seaworthy properties of the Indian canoes are often put to a severe test, as a very ugly sea gets up in no time when a storm comes on. It is however in shooting rapids that the skill of the Indian voyageur is seen to its best advantage; and it is safe to say they will often guide these frail bark boats down tremendous rapids, which would test to the utmost the strength and buoyancy of many a stoutly built European boat, as well as the sailor-like qualities of her crew. In forest travelling however the lumbering white man's boat is but a poor substitute of the light Indian canoe, especially in going up-stream, when falls and other obstructions require frequent portages; the bark canoe can then be carried by one man.

It has been well said that "necessity is the mother of invention," and certainly we venture to think that the birch bark canoe is by far the most wonderful instance that has ever been recorded, of scientific invention and construction executed by savage races. These remarkable boats, we do not hesitate to say, would have shed a ray of glory upon the constructive genius of our best naval architects, had they been invented by them. They are very light and buoyant, and withal so strong, that they float like a cork on the most troubled waters. They are however easily upset, by incautious persons unaccustomed to their management; as having no keel, they have no hold upon the water to maintain their stability—but the Indian by balancing himself like a rider on horseback, rarely gets overset; and should he at any time do so, he can swim alongside and right his boat again, and after bailing it partially out, can climb on board over one end and

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continue his voyage, though some of his effects when sinkable may get lost occasionally.

We must now turn our attention to the grand family of pine trees, which always take a leading place in every description of North American forestry—the numerous varieties of these trees, whose name is legion, undoubtedly formed what were even in quite recent years, the largest and finest forests in the world; for magnificent and justly renowned though many of the Canadian and United States forests near the great lakes and the eastern seaboard unquestionably were; it is now well known that all the largest and handsomest trees are mostly strictly confined to the region lying to the westward of the Rocky Mountains, extending from California to British Columbia and Alaska.

Of the trees on the eastern seaboard, it is almost universally conceded that the "Pinus Strobus" is the most valuable from a commercial point of view. This tree furnishes most of the American "white deal" timber, so well known in the European markets; and in England it is known as the Weymouth Pine, from the absurd reason that some plantings grown from seed imported from America, proved a success near Weymouth.

The habitat of this grand American tree is in portions of the northern United States and Canada, where it forms splendid natural forests of vast extent, along the banks of rivers and in fertile valleys and bottoms. The trees grow pretty thickly together, the trunks often ascending in favourable situations to 100 feet or more without a branch; the growth of a grove of these pines being very uniform and gregarious, the under

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branches die for a long way up the stem, and drop from the trees of their own accord—Nature thus enabling them to prune themselves, while the dense canopy of interlacing branches creates so deep a shade, that the ground is often quite bare below, rendering it open and easy to traverse in consequence of the absence of underwood. Bracken and but little else, grows beneath, and the foot treads noiselessly on a soft slippery surface of fallen tassels.* Unfortunately such a lot of white pine trees was just the thing to attract the attention of a gang of lumbermen, whose destructive axes soon laid every fine specimen low, so that it is to be feared a grove of this kind is now becoming conspicuous only by its absence, or at least being only to be found in the remoter solitudes of the forest, where long and expensive expeditions must be taken to reach them, though occasional groups of these majestic pines may still be found, "and their summits seen at an immense distance, aspiring toward heaven, far above the heads of the surrounding trees." †

In former days gigantic specimens of the Pinus Strobus were common, and almost matched the magnificent trees that are yet to be seen in Oregon and British Columbia. Mr. Lambert, a well-known authority on the pine tribe, speaking of the Pinus Strobus, says:—

"It is certain that among full-grown trees on the best ground, there are some 200 feet high, and 4 to 5 feet in diameter at the lower end of the trunk. Wangenheim tells us that he

* *Forest Life in Arcadia*, by Capt. Campbell Hardie, R.A., 1869, pp. 27—29.

† *Echoes from the Backwoods*, by Capt. R. G. A. Levinge, 1849, Vol. i., p. 285.

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was convinced of the truth of this statement when he saw in the dockyard at Plymouth, two masts for 74 gun ships, which measured in the whole piece, 108 feet in length, and the roller was everywhere 3 feet in diameter. Such a tree must have been 200 feet long, and 5 feet or more in diameter." *

But grand and majestic as these great specimens of the Pinus Strobus undoubtedly are, they must yield the palm to some of the pines of the forests of North Western America. There are many other trees in Canada and the Eastern States which are well worthy of a short description, but we must hurry on to glance at the gigantic trees found in the great primeval forests of the Pacific coast.

The first of these of which we shall speak is the *Abies Douglasii* or Douglas fir, the finest specimens of which have, we believe, been found in Vancouver Island, and on the Frazer River, where it forms extensive forests. It is one of the most beautiful and valuable of all conifers, and grows to a size truly gigantic. On the site of what is now Vancouver city—the present terminus of the Canadian Pacific Railway—and in the neighbourhood of that town, on Burrard Inlet, was a renowned group of these trees, and "many still standing around the city, are from 250 to 350 feet high and 12 feet in diameter at the base, or about 36 feet in girth," † growing so close together that the trees almost seem to touch each other; for the same description goes on to say, that "another thing which surprised us was the small

* *Description of the Genus Pinus*, by A. B. Lambert, F.R.S., 1803, Vol. i, p. 32.

† *By Track and Trail through Canada*, by Edward Roper, F.R.G.S., 1891, p. 185.

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space between the trees; there hardly seemed enough room to pass between them." *

On the opposite coast upon Vancouver Island equally large specimens are sometimes found, thus we hear:—"Mr. Smith, a farmer of Cowichen told us of a Douglas fir in his neighbourhood, 12 feet in diameter 10 feet from the ground, and at the ground it was 50 feet around;" and again "Planks of 6 or 7 feet wide, and 80 feet long, are frequently cut from the Douglas fir. This shows the immense size of the timber." †

In the South Kensington Museum, London, a section of an *Abies Douglasii* is exhibited, cut in the neighbourhood of the Frazer River, in 1885, the number of whose rings show that it was then 533 years old: this takes us back to 1352, the 25th year of the reign of Edward III. This tree was about 6 feet in diameter, where the section was made, and on it are marked the dates of various remarkable events in the world's history, co-temporary with certain of its rings, formed during the period of its lifetime. It was already a large tree at the time of the birth of Shakespeare (April 23, 1564) and since 1776, the date of American Independence, it has only increased in diameter about 9 inches. At the time of the Battle of Poictiers (Sept. 19, 1356) it was growing as a stout seedling, in the silence of these great primeval woods. §

These facts furnish us with an apt illustration of the

* *By Track and Trail through Canada*, by Edward Roper, F.R.G.S., 1891, p. 185. [N.B.—The Douglas fir has already proved itself to be one of the most valuable conifers ever introduced into the British Islands, both as an ornamental. and as a timber tree. In favourable situations, it is probably the quickest growing of all firs, and its shoots will frequently measure from 4 to 5 feet during a single season's growth.]

† *Life and Labour in the Far Far West*, by W. Henry Barneby, 2nd edit. 1884, p. 137.

§ Notes taken by the Author in South Kensington Museum.

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ephemeral character of human existence, and tell us how small a thing is the life of the individual man when compared to that of one of these great trees.

Then again, in the Botanical Gardens at Kew, there is a flagstaff made from a pole of the *Abies Douglasii*, brought from Vancouver Island, and presented to these gardens in 1861. It is 159 feet high, and weighs 4 tons 8 cwts 2 qrs., and the age of the tree was about 250 years. * It is generally supposed that this is one of the highest flagstaffs in the world, formed from a single tree. Nevertheless England furnishes us with instances of other noble flagstaffs still superior in dimensions—thus the flagstaff on the Round Tower, at Windsor Castle, which has been standing for more than 50 years, has recently been condemned by the War Office Authorities, who have ordered its removal and "a new staff will be forwarded from the Dockyard at Portsmouth. The condemned staff is 170 feet in height, and is 5 feet in circumference at the base." †

Unfortunately we have not been able to ascertain the precise variety of tree from which this latter great staff was formed, or whether it was built up, or made from a single piece of timber—but at any rate, no one can deny that it formed a right worthy pole, from which the Royal Standard of England has floated for over half a century.

It is quite worth our while to revert for a moment to the accounts which have been given of the splendid forests which even still surround the Pacific Terminus of the Canadian Pacific Railway at Vancouver City.

* Details given on a plate attached to this flagstaff, copied by the Author on the spot.

† *The Globe* (London Evening paper) of Sept. 1, 1892

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The town, as we have said, is situated on the edge of Burrard Inlet, a natural arm of the sea, some 17 miles long, which forms a perfectly land-locked tidal basin, with still deep water almost everywhere coming close up to the shores. Hills rise abruptly from the water's edge on every side, covered with magnificent forests of Douglas fir, * Hemlock Spruce, † and Cedar, § which descend to the very edge of the sea in every part of the inlet. Strong tidal currents exist almost everywhere in these seas, and near the mouth of this inlet, at a place called "the narrows" at certain stages of the tide the water runs like a mill race, at perhaps 6 or 7 miles an hour. This description may be said to hold good for nearly all the inlets on the British Columbian coasts, which are very numerous, and nearly all of which we have visited: the waters of which are sometimes so deep that it is frequently difficult for a ship to anchor at all; they are also beautifully clear, and numerous fish may frequently be seen swimming beneath their surface and disporting themselves in the tide rips. Salmon and sea trout swarm in all these waters, forming a very paradise for anglers, as the reader will see in the more particular accounts of this region given in our section on "Fishing"—for this is a country we are well acquainted with. The scenery in many of these inlets too, is magnificent, reminding one greatly of Norway, which has much the same kind of coast and scenery, minus however, the superb, and never-to-be-sufficiently-admired forests, of whose regal grandeur and magnificence we purpose now to give a short account. The Norwegian forests are *as nothing* in comparison.

* *Abies Douglasii.* † *Abies Canadensis.* § *Thuja Gigantea.*

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Mr. Barneby, who in 1884 published an account of an excursion he made along the shores of Burrard Inlet a year or two previously, says:—

"We trudged along through wonderfully dense forests for about three miles. It is impossible to describe how dense and beautiful it was. Moss hung from many of the trees; indeed, numbers of these were covered with ferns, hanging mosses, and creepers—and many plants I did not know the name of grew in every direction—I never saw before, such a charming forest scene; and I must also acknowledge, that until this trip, I never before saw real trees—I mean trees of such immense growth. The timber here was magnificent, and the foliage most luxuriant, the colour of the leaves being beautiful in the extreme. It was quite like fairyland. The ferns were sometimes several feet above our heads." *

In a still more recent book by the same author, he gives an account of an excursion made in a buggy, from Vancouver City along a road newly made through the forest. First he alludes to the fearful destruction wrought by lumberers among these noble trees, and says:

"For a mile we had to pass through burning stumps of Douglas pine on each side, as the process of clearing is making rapid strides in this direction. In travelling by this new road it seemed odd to find some of the stumps of trees, divided into two, the centre being taken out, in order to get a proper width of track, instead of being cleared away at once. This shows what an immense size these trees must have been, as a portion was left on either side of the road. We were soon in the primeval forest, where Douglas pines were the chief feature, running straight up from 100 to 200 feet. We travelled along a gravel ridge until we reached what

* *Life and Labour in the Far Far West*, by W. Henry Barneby, 2nd edit. 1884, pp. 120—21

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is called a 'Cedar Bottom': and in order to properly appreciate these forest scenes in all their perfection, commend me to a 'Cedar Bottom.' The one I allude to, is supposed to have been originally caused by a beaver dam. Hemlock, cedar, and Douglas pine were there, running up to such a height that it almost made one giddy to look up: moss 4 or 5 feet long hung from, and intertwined itself round the branches, and the ground must have been covered yards deep with trees of all descriptions, rotting with age, lying on the ground in every possible position. The whole scene was as perfect a picture of untouched Natural beauty as could well be imagined: and no description can do justice to it. The skunk lily, and many varieties of ferns, tended to show the dampness of the spot, and also to make me realize how lovely a fernery can be —without the aid of art." *

We might go on almost "ad infinitum" adding paragraph after paragraph to a similar effect, culled from the works of various authors; for many books have been written about it. More than 35 years ago we ourselves traversed these forests on foot in company with Indians. We have hunted through them, and fished in their streams and inlets, before the white man had made any settlement in them; and encamped beneath their shadows before the silence of these grand old woods had been broken by the lumberer's axe, or their natural beauty defaced by the work of destruction which has since been commenced in them: —a destruction which it is grievous to us to hear of. At that time, New Westminster, the capital of British Columbia, was itself a mere collection of a few log houses, planted in a gap cut in the forest upon the banks of the Frazer River, and dark and lofty walls of pine

* *The New Far West and the Old Far East*, by W. Henry Barneby, 1889, pp. 64 to 66.

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enclosed it on every side. Burrard Inlet was then a place rarely visited by white men, and could only be reached by a narrow Indian trail, whose devious windings led to it, through the heart of this grand forest, a distance of 6 or 7 miles, and so far as we are aware not a single settler's cabin then existed upon its shores.

Now—a great city is rising in what was then the Wilderness *—the railroad coasts along its verdant slopes, and spans the continent from sea to sea. Nor perhaps is it too much to predict that before another generation has passed away, Burrard Inlet will be one of the great emporiums of the commerce of the world—but its wild and desolate grandeur, its Indians, its magnificent forests, its game, and gigantic trees—all will have disappeared, and their memory will consist only in a name.

There is another tree, which has been already referred to as common in these woods, which is hardly less remarkable in its size and growth than the Douglas fir,—namely the yellow cedar (*Thuja Gigantea*). It is a species of a gigantic, and sweetly scented *arbor vitæ*, of very rapid growth, whose range extends all over North Western America. † It is found growing in the forests of the arctic province of Alaska, and seems to do particularly well in the northern parts of British Columbia and in the Queen

* Vancouver City—Western Terminus of the Canadian Pacific Railway, and probable great British N.W. American seaport of the 20th century.

† Seedlings of this tree succeed admirably all over the British Islands, and we consider it one of the most valuable additions to our sylvan treasures that has been introduced of late years. It passes under several names in Nursery Catalogues.

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Charlotte Islands—a group of wild, and densely wooded islands, which on account of lying in the track of a warm ocean current, are blessed with a singularly mild and genial climate, considering their latitude; so that in consequence trees of marvellous size are said to be met with in their forests. The bark of this cedar is of a fibrous nature so that the Indians manufacture ropes, cords, and mats from it. * It is from this tree also that the Indians make their large canoes, which are really very fine sea boats, and most excellent craft in every way. The birch-bark canoe is never seen on the Pacific coast; the dug-out takes its place, and is of course, as its name denotes, constructed out of the trunk of a single tree.

The finest specimens of these great canoes are made by the Hydahs, the Bella-Bellas, and other tribes inhabiting the Queen Charlotte Islands, where they are fashioned by the native workmen with wonderful skill, partly by the aid of rude tools, and partly by that of fire, upon beautiful lines very similar to those of a clipper ship. They are made of all sizes, from a small boat capable of being worked by one or two men, to a gigantic affair capable of crossing the stormy sea which separates these islands from the great island of Vancouver, and the mainland, even in pretty heavy weather. A large canoe of this kind has frequently been known to make her passage under these circumstances, paddled by 30 or 40 persons, and carrying several tons of freight in addition to her crew. In former days a descent of a fleet of these canoes, manned by these warlike natives, was much dreaded by the tribes all along the coast.

* See *The Queen Charlotte Islands*, by F. Poole, C.E., 1872, p. 114.

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Merchant vessels trading along the N.W. coasts have often been known to fall victims to the attacks of these pirates, who massacred the crews, pillaged and burnt the ships, and so left nothing behind that might indicate the fate that had befallen the unfortunate ship; though the truth generally leaked out in the end, from reports circulating among the other tribes, some members of whom were pretty sure to have witnessed what occurred, while they themselves were securely concealed, shrouded in the shadow of the great and pathless forests that enclosed these waters, which are seldom so broad as to be beyond the reach of the eagle eyes of these watchful savages.

Another beautiful and most ornamental tree somewhat similar in character to the giant cedar, is the Nootka Sound cypress (*Cupressus Nutkaenis*, [Lambert]), perhaps more generally known as the "*Thuiopsis Borealis*" (Fischer), mostly found on the Western coasts of Vancouver Island, where it forms a large and beautiful tree, growing to 100 feet in height, and 4 feet in diameter. * Many fine specimens of this tree, and of the giant cedar, adorn the lawns of English parks where they have been found perfectly hardy, and they are moreover a great acquisition to most European collections.

Among the silver firs most remarkable for size and beauty in British Columbia, and North Western America generally, we may mention *Picea Grandis*, originally discovered by Douglas in Northern California, but afterwards found in great abundance by Jeffry, along the banks of the Frazer, according to whom specimens of it were found near Fort Langley 280

* Gordon's *Pinetum*, 1880, p. 94.

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feet high, 5 feet in diameter, and with a trunk of 50 feet without branches. * *Picea Amabilis* is another magnificent tree of at least as gigantic a growth, seen towering above all other trees in the forests of Northern California.

It was also found growing by Jeffry on the mountains to the eastward of the Frazer River, in Lat. 50°, where he saw it growing in gravelly soil to a height of 250 feet, and 5 feet in diameter, with 60 feet of stem without branches. †

Picea Lowiana is another splendid tree of almost equal size, found throughout North Western America in valleys, and along alluvial flats near rivers, growing 250 feet high, and measuring 5 and 6 feet in diameter. §

Picea Magnifica is yet another, furnished with beautiful glaucous foliage, forming immense trees in the Sierra Nevada and Upper California. **

But the gem of the whole collection, from an ornamental point of view, is undoubtedly the *Picea Nobilis*, which is found on the Columbia River and Northern California, growing to a height of 200 feet, remarkable, like the last named, for its peculiarly beautiful glaucous foliage of a deep blue-green tint, and its singularly striking cinnamon-coloured bark. This noble silver fir is found ascending the mountain sides to an elevation of 8000 feet. In Northern California, according to Douglas, it forms vast and majestic forests, through which he wandered for weeks, noting their botanical treasures; at one time he says:—"I spent three weeks in a forest composed of this tree,

* Gordon's *Pinetum*, 1880, p. 217. † *Ibid.*, p. 217.
§ *Ibid.*, p. 218. ** *Ibid.*, p. 219.

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and day by day could not cease to admire it." *

These brief details will serve to give some idea of the extraordinary vegetable wealth, the splendour, and enormous size of the trees in the forests of the great North West, and which may undoubtedly be regarded as the finest and most valuable in the world. But these giant trees above mentioned are only a few among many, and by no means exhaust the list of those concerning which we should have liked to say a few words, did we not fear to appear too prolix and thus weary the reader.

For instance, of the tree pines, the pitch pine (*Pinus Ponderosa*), the singularly lovely Lasiocarpa, and the truly gigantic sugar pine (*Pinus Lambertiana*) which runs up straight as an arrow to quite 300 feet in height, and upon whose edible seeds the forest tribes used to live in the winter time, are notable instances in point—the resin of this last named tree is also sometimes used as a substitute for sugar, † and hence no doubt the name of sugar pine. There are also an infinite variety of flowering plants and shrubs and beautiful evergreens, such as the arbutus and the evergreen oak, which grow magnificently in California. "I could hardly (says Mr. Barneby) have imagined that evergreen oaks could attain to such magnificent proportions" §—but the list of vegetable wonders would be indeed singularly incomplete if we omitted to mention two of the greatest of all namely: the giant Sequoias, the largest and noblest of trees—these are, the *Sequoia Sempervirens*, a lofty evergreen known as the

* Gordon's *Pinetum*, pp. 207—8.

† *Ibid.*, p. 307.

§ *Life and Labour in the Far Far West*, by W. Henry Barneby, 1884, pp. 61, 62.

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Californian red wood cedar, growing at least 300 feet in height, a specimen of which has been found measuring 55 feet in circumference, * and the mammoth *Sequoia Gigantea*—generally known in England as the *Wellingtonia*, while the Americans insist that it is the *Washingtonia*. These absurd cognomens, named after men neither of whom ever saw the trees, and the latter of whom was dead long before they had been discovered, may well be left to settle their respective claims among themselves. The *Sequoia Gigantea* seems to have been first discovered by Douglas, a British botanist and traveller in California, in 1831, and one of its peculiarities is that it does not grow singly about the country, but only in groves, of which the principal ones at present known are that in Calaveras County, the Mariposa, the Fresno, and one or two other minor groves—of these the largest trees are still said to be original "Big Tree Grove" in Calaveras; where at the time of our visit there was a tree lying on the ground, partly destroyed by fire, which competent judges declared must have been 450 feet high and 60 feet in girth. It was called the "Father of the Forest"—and there were others still standing not very much smaller than this giant. In the Mariposa grove, which contains nearly 1000 trees, the largest specimen is said to be 325 feet high and 92 feet in circumference. Most of these trees are as straight as an arrow and are very similar in this respect in all the groves, where they constitute the perfection of natural beauty both in their growth and colouring. The sight of their enormous stems, rising up from the earth like gigantic natural columns, sheathed in a bark of bright cinnamon red

* Gordon's *Pinetum*, 1880, p. 379.

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hue; their great height, girth, and magnificent proportions—all contribute to create an impression upon the beholder which can never be effaced. These groves are however now so well known (being visited by thousands of tourists every season), that it would be out of place to enter into any detailed description of them in these pages, as such can be found better detailed in guide books and tourists' narratives.

We would not, however, have the reader forget the vast antiquity which these trees represent in the world's history: it has been variously estimated at from 3000 to 4000 years—perhaps more. These venerable patriarchs of the forest were probably some of them gigantic trees at the time of the Christian era—and may still bid defiance to the storms of time for thousands of years to come. Their great enemy seems to have been, *not* the weight of years and the natural decay due to age: but rather the destruction wrought by forest fires, which seem to have done more than anything else to lay the giant specimens low and injure the beauty of those still upstanding.

The vitality of these trees seems to be something almost incredible, as the fresh bark overgrowing charred cavities seems to prove: the enormous thickness of the bark being such, that they can bid defiance to forest fires in a way no ordinary tree could hope to do. Time, the destroyer, has in all other respects evidently dealt gently with these aged trees—they have stood for thousands of years already, and long may they continue to do so, superior to all the accidents of time and change.

Heretofore we have said nothing of the trees of the

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southern temperate zone, but if we go to Australia we shall find in the noble eucalypti (there called "gum trees") worthy rivals of the giant Sequoias.

These remarkable trees give quite a special character to Australian scenery, and undoubtedly constitute the most notable feature among the vegetable products of that continent: their sombre bluish green foliage, and peculiar tough sabre-like form of leaf, at once attract attention when contrasted with that of other trees, as we find in Egypt and Algeria, where many varieties of eucalypti are now grown from seed imported from Australia, and form noble looking trees, which grow with immense rapidity.

The banks of rivers and watercourses in Australia are generally bordered by eucalypti, which often attain a gigantic size, and grow to a height of more than 250 feet, with a girth of from 12 to 20 feet.* The natural habit of these trees (which belong to the family of the *Myrtaceæ*) is to shoot up straight as an arrow, with comparatively few large branches; and they bear blossoms like a myrtle, the flowers being mostly of a pinkish or yellowish white colour. But there are numerous varieties,† and eucalypti are so plentiful in Australia, that they compose almost four-fifths of the forests.§ Some are of dwarf habit, but other grow to a truly gigantic size and vie with the Wellingtonia (*Sequoia Gigantea*) of California for the honour of being the largest trees in the world, a claim

* Stanford's *Compendium of Geography and Travel for Australia*, Edited by Alfred R. Wallace, 1879, p. 40.

† The *Eucalyptus Felicifolia* or fern-leafed eucalyptus of S.W. Australia is an example of a variety bearing magnificent trusses of crimson flowers.

§ *Outlines of the Geography of Plants*, by Professor F. J. F. Meyen, of the University of Berlin, 1846, p. 137.

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which according to Stanford's Australian Compendium of Geography is justified by fact, for it is there stated that

"one huge specimen, which lay across a stream, was found by measurement to be 435 feet from its roots to where the trunk had been broken off by the fall. This broken end was 3 feet in diameter, so that at the lowest estimate the entire tree must have been over 500 feet: by far the loftiest tree yet ascertained to exist on the globe; at 5 feet from the ground it measured 18 feet in diameter, and was probably of the species *Eucalyptus Obliqua* or *Amygdalina.*" *

It had been much burnt, and its top entirely destroyed, so that it appears to have been difficult to decide upon its exact variety. This great eucalyptus must therefore have evidently been considerably taller than the largest of the Californian Sequoias, the very highest of which is not supposed to have exceeded 450 feet, and like its great Australian rival, this tree was also partly destroyed, so that it was impossible to give its original size, except from conjecture.

According to Stanford, however, in the Dandenong range, 40 miles east of Melbourne, the ravines contain numerous eucalypti over 420 feet high, and one fallen tree was discovered of 480 feet.†

The foliage of the Australian gum trees (*Eucalypti*) exhibit a striking peculiarity, being evidently intended by Nature for maintaining existence in a country where intense heat and drought prevails; the leaves of most of them therefore, are so arranged as to hang quite straight down, thus presenting themselves edgeways to the

* Stanford's *Compendium of Geography and Travel for Australia*, Edited by Alfred R. Wallace, 1879, p. 172.

† *Ibid.*, p. 41. [Visitors to Australia often make excursions from Melbourne for the purpose of seeing these trees, a trip which is well worth making].

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sun, so that they avoid exposure to the full power of its rays, and while pendant in this position have the peculiarity of throwing no shade whatever upon the ground below. Thus Colonel Mundy among other travellers mentions this curious fact, and says that: "the foliage of the gum tree is so thin and pendulous that when the sun is overhead, one rides through the bush, almost as unsheltered as if there had been no trees." * Moreover the leaves themselves are quite different in their texture from those of most other trees: being extremely thick, hard, and leather-like, so that in very dry times they do not wither for want of moisture, as more delicate foliage would naturally do. All of them, when bruised, and forcibly broken up between the fingers, have the peculiar aroma of eucalyptine and exhibit a dry wiry texture, more resembling parchment than living foliage; we speak, of course, of the old and matured leaf, and not of the young foliage. Eucalypti never shed their leaves after the manner of deciduous trees (the number of deciduous varieties is very small); their leaves all contain considerable quantities of oil, and those of most species are strongly scented, and very inflammable, but few of them are however eaten by stock. The eucalypti as a rule are avoided by grazing animals on account of their strong odour and taste.

The hot winds of Australia, which form so remarkable a feature in the meteorology of that continent, as we have not failed to point out in our section on "Climates and Temperatures," are sometimes exceedingly trying to vegetation of all kinds, and their heat very intense—and temperatures of 110° F. and upwards have

* *Our Antipodes*, by Lieut.-Colonel G. C. Mundy, Vol. ii., p. 28.

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been registered at Sydney. These winds at times continue to blow for a considerable period without intermission, their direction being N.W. to S.E.; a current of hot air being evidently almost always passing in the great altitudes of the higher atmosphere in that direction, so that when this hot current is deflected by any disturbing cause it sometimes descends, so as to reach the earth, and hot winds are the consequent result. These winds blew with fearful intensity for nearly a month without ceasing, in the early part of 1896.

The frequent occurrence of long droughts and hot winds in Australia therefore, rendered some expedient an evident desideratum, to protect vegetation from their withering effects; and so we see Nature's simple and effective counter-move is that the foliage of the trees hangs so as to elude their influence, and instead of presenting their full front to the sun in the usual way, the leaves present themselves edgewise to the heat.

In closing this brief notice of the eucalypti, their remarkable febrifuge qualities ought by no means to be forgotten—for they are highly prized on account of their supposed anti-malarial properties; plantations of the *Eucalyptus Globulus*—or blue gum—being believed in some way to destroy malarial germs. The French have introduced them largely, for this reason, into their North African colonies, the anti-malarial power of the eucalypti being with them almost an article of faith, though it is not quite certain in what way the effect is produced; but it is almost universally admitted that localities which were formerly highly malarious, have since the introduction of this gum tree become free from malarial disease. We may mention the case of Bona, on the N.E. coast, as one of the places where

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eucalypti are alleged to have produced a highly beneficial effect.

Preparations made from eucalyptus bark have also come largely into use as disinfectants, and nobody can deny that their penetrating odour, at any rate, masks other smells of a more repulsive character: frankly, however, we are of opinion, that it merely *masks* them, but we do not believe that it in any way alters their specific character.

Here again we are brought face to face with a number of considerations of too long and too technical a nature to permit of our entering into them here. Suffice it to say therefore, that *deodorants* are in no way necessarily *disinfectants*. Indeed, in the proper and scientific sense of the term, we fear it must be said that thus far no regular *disinfectant* is known. This of course at once raises the whole question as to what is infection?—Now, infection is generally believed to depend upon the existence of certain living organisms, or specific germs, conveyed in various sorts of ways, which are not necessarily mal-odorous at all; and the only means by which disinfection can be said to be effected, is by the destruction of these germs by some means—as for instance by a high temperature—and the consequent "sterilization" of the infective medium.

Then as regards the supposed antimalarial properties of eucalypti, this again raises a fresh cloud of hypothetical points impossible to deal with here: much too little being known of the real nature of malaria to warrant any dogmatic assertions being attempted; but if we might be allowed to express an opinion upon this matter, we are inclined to regard these trees simply as *water-absorbing mediums*, which by

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drying up the soil in a great measure, thus help to destroy what is called "malaria." We believe that in this way the eucalypti, and also the banana, and many other plants, have a very great effect upon the health of a locality. Moreover the cultivation of the soil of itself greatly assists in destroying malaria, when it has been carried on for some few years.

This question of the capacity of the leaves and roots of trees and plants for transforming and absorbing what is hurtful to our existence, in the decaying proceeds of animal and vegetable substances, has always appeared to us to be one of the most beautiful of all natural phenomena. Before we pass on to other matters, however, we may just mention that an oil has recently been discovered which is expected to prove a valuable acquisition for so-called antiseptic and deodorizing purposes. It is distilled from the *Eucalyptus Citriodora*, a species indigenous to Queensland, which is deliciously scented. This oil is also expected to be valuable for inhalations in pulmonary affections etc. * The young leaves of this tree rubbed between the fingers have a strong aroma of fresh lemons. Another Queensland variety, *Eucalyptus Staigeriana*, or lemon-scented iron bark tree, is also delightfully fragrant, and a cosmetic oil of high excellence is distilled from it also. †

Among the coniferous trees belonging to the forests of the temperate zone, in the Southern hemisphere, which call for a few words of notice, is the Kauri pine of New Zealand (*Dammara Australis*), a resinous

* See Notice of this oil in *Lancet* of Oct. 3rd, 1891.

† See *Select Extra-Tropical Plants eligible for Industrial Culture*, by Baron Ferd. von Mueller, Government Botanist for Victoria, 1891. p 188. (Printed for the Government of Victoria).

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and cone-bearing tree with long leaves somewhat resembling those of the box-tree.

It used to exist there in enormous forests, and has sometimes been lauded as the best timber which grows anywhere on the globe, and as much more durable than any other. * Unfortunately it is not a hardy tree, † and has not proved a success when tried out of its own country; it is also very slow growing, taking quite as long as, or longer than, the oak to come to maturity, and it is said to take 800 years to attain its full size, probably because it grows on rocky and barren volcanic soils. Its principal habitat is in the province of Auckland in the North Island, where it grows to 180 or 200 feet in height, with a diameter of 6 or 7 feet, and clean stems of 80 feet or even 100 feet without a branch; trunks up to 15 feet in diameter are however said to have been met with in the ancient forests, before the lumberer had made havoc among these woods. But these splendid trees are now a thing of the past, and at the present rate of cutting, it is to be feared that in 25 or 30 years the Kauri pine forests of New Zealand will become absolutely extinct.

One of the products of the Kauri pine was a species of amber-like gum, known as "Kauri gum," which used to be naturally distilled by the ancient trees in large quantities; masses of it of considerable value being still found in the ground, from which the forests have disappeared, where it had collected in former days, at the roots of old trees—and it is stated that in 1876, several thousand tons of this gum, valued

* *Timber and Timber Trees*, by Thomas Laslett, Inspector to the Admiralty, 1875, p. 297.

† Gordon's *Pinetum*, 1880, p. 109.

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at £109,000, were exported.* Colonel Mundy, who paid a visit to the Kauri forests in the good old times, mentions that at the time of his visit he saw

"one tree just felled, which was about 6 feet in diameter, with about 50 feet of perfectly straight wood. There was another grand stick 9 feet in diameter, a slice of which would have made a round table of 27 feet. This tree was still standing in all its glory, and seemed to have about 80 feet of bole, little diminishing in size before the branches, and was calculated to contain 8 to 9 thousand feet of solid timber. This was not a particularly fine stem however, for some have 100 feet of straight wood, with a fine head towering high above the forest." †

Mr. Laslett, whose experience in H.M's dockyards entitles him to speak with authority on the subject of timber, considers the Kauri pine timber unrivalled in excellence for masts and yards,§ and thinks "that it may be considered one of the best woods for working that a carpenter can take in hand." ** He had an opportunity of admiring these splendid trees in their native forests, and says, the largest tree he saw "was one standing near Mercury Bay, 80 feet to the branches, and 72 feet in circumference." †† In the South Kensington Museum a transverse section of a fine specimen of a Kauri pine is exhibited, highly polished, and of the colour of the finest dark mahogany. We regret to say, however, this splendid tree possesses such peculiarities of constitution that it

* Stanford's *Compendium of Geography and Travel for Australia*, Edited by A. R. Wallace, 1879, p.

† *Our Antipodes*, by Lieut.-Colonel Q. C. Mundy.

§ *Timber and Timber Trees*, by Thomas Laslett, Inspector to the Admiralty, 1875, p. 297.

** *Ibid.*, p. 298.

†† *Ibid.*, p. 295.

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has not succeeded when transplanted to Australia and other situations outside its natural habitat, and it is to be feared that its extinction is imminent. In the Botanical Gardens at Sydney only one or two wretched specimens are exhibited. Other varieties of the Dammaras are however seen there growing well, and apparently quite healthy, but all these are tropical species imported from some of the South Sea Islands of which their are four or five different kinds.

The fear of being considered tedious will prevent our noticing more of the forest products of the southern temperate zone; as before closing this section we desire to give a brief consideration to the curious question of the succession of forest growths, which take place when the primeval forest is destroyed, either by human agency, or by accidental causes, such as fire or tempest; for it has been a universal subject of remark all over Canada and the United States that, as a rule, when the destruction of the original forest took place, the *same kind of forest did not reappear*, but that a new sort of forest, composed of different trees, replaced the old.

But this rule evidently must not be accepted without reservations, for in Oregon and British Columbia we ourselves have repeatedly traversed tracts of recently burnt forest, with the dead and withered stems of the ancient pines still upstanding, while a new growth of pine seedlings similar to the surrounding forest was springing up from the parent soil as thick as grass upon the prairie.

Nature's great rotation of forest crops is nevertheless a matter of ascertained fact—and as a rule where a pine forest has been destroyed, it is replaced by a

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forest of deciduous trees; and where deciduous trees have grown, a pine forest takes their place. This circumstance has been so repeatedly and generally noticed by settlers and others who have written upon life in the backwoods in Canada and the United States, that we deem it unnecessary to do more than state the fact. It is an article of faith among almost all those with whom we have conversed upon this matter.

Now, if we consider for a moment how vast a period of time the life of these ancient trees represents, this great law of the rotation of Nature's crops becomes not a little impressive. For ages the giant pine trees have overshadowed the ground, and year after year they have shed their seed in countless myriads all over it—layer after layer of it lies buried in that exhaustless soil. Why then should their ancient race and lineage be utterly blotted out, and the stranger enter in and possess the land? And from whence do the germs of the alien crowd proceed?—It is true that seeds may be carried about in great abundance by birds, and certain kinds of them even by the gales. By these means seeds become scattered all over a vast extent of country; and it seems difficult to come to any other conclusion than that the existence of these germs there at all must be due to some such agency.

But why should *they* alone survive? And why should the succession to the ancient stock entirely fail?

These are questions into which it may se
beyond our province to enquire—a
depend upon it there is a reason
obvious, which would at on

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of the old and the success of the new regime: and if we might venture to hazard an opinion upon the subject, we should say that it is because some vital chemical principle of the soil has been exhausted by the ancient forest: the land is therefore in a comparatively barren condition for producing a fresh crop of the same trees, consequently they either do not germinate at all, or else are of such weakly growth that they are quickly choked by the rank grasses and weeds, and the vigorous undergrowth of bushy shrubs, which are generally the first crops that spring from the fallow ground of the clearing.

On the other hand some other chemical principle, which was not necessary to the growth of the ancient trees, and therefore was not assimilated by them, has accumulated in the soil for ages, and this, being highly favourable to the growth of other kinds of trees, their seed is enabled at once to take root, and oust the former tenants from their inheritance. Such, we venture to suggest, is a simple and probable explanation of this apparent mystery.

The necessity for a proper rotation of crops is a well-known principle in agriculture, recognised for ages by all competent farmers and gardeners. "It is a well-known fact," says Thompson——

"that the same kind of crop cannot be successfully grown on the same ground for several consecutive years. Farmers know that if land be too frequently cropped with clover, it becomes what is termed "clover-sick," and refuses to produce that crop, till a considerable space of time has elapsed. Various theories have been formed as to the causes which render the rotation of crops necessary. De Candolle supposes that the roots have the power of excreting, or throwing off,

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substances unnecessary or injurious to the plants to which they belong. But it has been found that excretion from the roots only takes place when these are wounded. This theory has therefore fallen to the ground. The next theory is founded on the exhaustion of the mineral substances contained in the soil. It has already been shown that inorganic substances are essential to the growth of plants, and that without mineral food plants cannot live. Now it is known that some plants contain a greater amount of certain mineral substances than others: for instance some plants require much potash or soda; others much phosphoric acid; some much lime; others a large quantity of silica. This being the case, it is evident that it would be beneficial to cause one crop, requiring only a small quantity of any particular substance, to succeed another requiring that substance in a larger amount. Such is the explanation of the beneficial results attendant on the rotation of crops." *

Now although, as Mr. Thompson points out, experiments upon this subject are as yet far from conclusive, it is evident that this theory, if it does not contain the whole truth, at least it approximates thereto—and that this is one of the main causes, though it may not be the *only* cause, which explains the natural law of the rotation of crops.

The laws of Nature are as old as time itself, and like the decrees of the Medes and Persians "unchangeable," and the law of the rotation of vegetable growths applies alike to the grass of the field and to the monarch of the forest. Again we find the same principle running through the whole economy of created nature, where change is the universal rule, everywhere unceasingly going on—in the animal, as well as in the vege-

* *The Gardener's Assistant*, by Robert Thompson, pp. 262—3 (a standard work on Kitchen Gardening, no date of publication given).

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table world. We are all the servants of Nature, appointed to do a certain work: and when a race, whether of plants, of animals, or of men, have served their time and their purpose, they are dismissed and must make room for another. Thus the number of extinct races and forms of life are innumerable —a few only of the most remarkable being probably as yet known to man, through the teachings of history and geology; whilst myriads of others, we cannot doubt, have passed away, leaving no trace behind.

The whole history of the world, from the earliest epochs to the present time, teaches us that races and types are all slowly changing, and nowhere is this truth more clearly conveyed to us than in the study of "The Wilderness and its Tenants," where in our own time we have seen whole nations and races of men and of animals disappear.

They had lived to become unsuited to their times. Peace be to their memory! The Scriptural parable of the unprofitable servant may, as we venture to believe, be interpreted in two ways; one of which represents exactly the dealings of Nature with the terrestrial world—whilst the passages here referred to state that this rule thus established on earth is identical with that of the Kingdom of Heaven. "A certain nobleman," we are told, went forth into a far country, leaving his goods to the care of his servants—in one passage the nature of the property so entrusted is represented by "talents," * in the other, it is "money." † "After a long time the lord of these servants cometh,

* Matt. xxv. 14—29. † Luke xix. 12—26.

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and reckoneth with them," * and found that some had proved faithful and profitable. Each of these therefore according to their respective merits, was rewarded and prospered in various degrees; while those who were unprofitable and worthless were cast forth, and their possessions passed into the keeping of others—such is the invariable law of nature.

Upon the destruction of the primeval forest, the new growth of trees is not always immediate; there is frequently an interregnum, during which the ground is occupied by various forms of herbaceous vegetation, according to the nature of the soil and locality. The ground is generally first covered by a luxuriant herbage of sweet grasses and ferns, which afford a delicate pasturage, most attractive to all grass-feeding animals whose home is in the forest—large numbers of these quickly discover and resort to these places, which thus become the favourite sporting grounds of the hunter in search of game, who should always endeavour to discover, and make himself acquainted with, the lie of such localities. It is not long however before the young trees begin to appear; and Mr. Rowan, an old settler, and a careful and intelligent observer of the forest fauna and flora, thus describes the usual course of Nature:

"Where a deciduous forest has been cut down or destroyed by fire, spruce and firs rapidly spring up. Where a pine forest has been destroyed, blueberries and raspberries grow in immense profusion, for two or three seasons; then cherry, white birch, maple and poplar commence to make their appearance, and shoot up with surprising rapidity; and soon a forest of deciduous trees replaces the ancient pine forests,

* Matt. xxv. 19.

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relics of which may be seen for 20 or 30 years, standing high over the young trees, with uplifted arms and blanched stems." *

In a very few years, the young forest becomes a thicket through which it is often difficult to pass, and it is evident that out of the crowded mass of saplings but a very small proportion can possibly survive to form trees.

Here another of the natural laws comes into force, viz., the law of the "survival of the fittest," nowhere to be seen to better advantage than in the struggle for existence among the new growth in a great forest. Everything that is weakly, stunted, or deformed, must of necessity perish—the most vigorous, and therefore the fittest, alone surviving. The lower branches of the trees of course, being bereft of light and air, always die, decay, and drop from the trees of their own accord. Thus Nature does her own pruning, she takes the nurseling under her own special care and keeping, and in due course of time lofty trees arise with stems clean and straight as an arrow; and so the great primeval forest once more resumes its sway over the land, and age succeeds to age, during which the giant trees, whose majestic size and appearance we have we fear but feebly endeavoured to describe, tower above their fellows and form the monarchs of the woods until the next metamorphosis.

Under no aspect, as we humbly believe, does Nature appear more truly *great*—far above anything that human imagination can conceive—than in this, her marvellous capacity for evolving these vast cycles of change, automatically succeeding each other through-

* *The Emigrant Sportsman in Canada, Experiences of an Old Settler*, by Mr. Rowan, 1876, pp. 270—271.

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out the course of ages. When the Creator set the clock of time in motion, and initiated the reproductive power of Nature, His work was *perfect:* that is to say, it was everlasting, it was self-regulating, self-supporting, self-perpetuating: both here on earth, and throughout the realms of space above.

It is on the contrary characteristic of every sort of human workmanship, that it is of necessity *imperfect*—decay and time are constantly at work upon it from the first moment of its construction; and unless constantly repaired and kept in order, it wears out, ceases to perform its functions and perishes. When therefore the Creator is represented as perpetually interfering with the course of Nature by ordering every trifling event through special interpositions of Providence: it has always seemed to us that this idea was founded upon a total misapprehension of the greatness and grandeur of His work, which was thus unconsciously robbed of half its glory. The works of man it is true, must be kept in repair, by a process of continual tinkering and supervision.

But the Divine work needs no such tinkering—no readjustments, no reparations. It is characteristic of its transcendent majesty and grandeur that it *alone* was in the beginning so perfectly adjusted *once for all* that thenceforth it continued to operate smoothly, efficiently, and for ever.

Among others Mr. Wallace, a careful observer of the various phenomena of Nature, was evidently strongly impressed with the same conviction, for he says, in words that cannot be too often repeated:

"I believe that the Universe is so constituted as to be self-regulating:—that as long as it contains life the forms

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under which that life is manifested have an inherent power of adjustment to each other, and to surrounding Nature; and that this adjustment necessarily leads to the greatest amount of variety, beauty, and enjoyment, because it does depend on general laws, and *not* on a continual supervision, and re-arrangement of details.—As a matter of feeling and religion, I hold this to be a far higher conception of the Creation and of the Universe than what may be called 'the continual interference hypothesis'" *

and again he observes:

"Why should we measure the creative mind by our own? or why should we suppose the machine too complicated to have been designed by the Creator so complete, that it would necessarily work out its own harmonious results?—The theory of 'continual interference' is a limitation of the Creator's power." †

We have ventured to call attention to this matter here, because we conceive that in the great rotations of the primeval forest we have one of the clearest examples of this self-adjusting power of Nature which is continually taking place under our own eye and observation—if we exercise it.

In the pine woods the appearance of the forest is of course much the same at all seasons, the trees being evergreen; but in the deciduous woods the variations of foliage are often most beautiful, both in spring and autumn, but especially during the latter season; in America, for instance, the fall of the leaf often exhibits a display of autumn tints whose colourings are frequently gorgeous beyond description; and we have

* *Contributions to the Theory of Natural Selection*, by Alfred R. Wallace, p. 268.

† *Ibid.*, p. 280.

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remarked, that it is specially so wherever the frosts of winter are severe; thus in Norway, Sweden, and Russia similar effects are produced upon the advent of the first frosts, and generally so all over the colder portions of the temperate zones. The colours are of all shades of reds, yellows, and browns, from dark crimson, bright golds, and russet browns to an infinite variety of more delicate shadings, of whose richness and beauty we can form no idea in the British Islands, though our autumn tints are often very fine also. But the Canadian and other North American fall tints are infinitely more brilliant, and justify the observations of a well-known American sporting writer, who remarks of them:—

"It is true, we know ourselves to be looking on, as it were, a hectic loveliness, which like the glow on the cheek of consumptive beauty, is the precursor of decay and death. Still so exquisite is that beauty, so delicious the temperature, the atmosphere, and the aspect of the skies; so gorgeous the hues of the forest, mantled mountain, and woodland, that to me the promise of spring, and the fulness of summer, are both inferior to the serene and calm decline of the woodland year, which seems to me to resemble rather the tranquil and gentle close of a well-spent life, enriched by the hopes of glories to shine forth after the winter of the grave, than the termination of an existence to be dreaded or deplored." *

The American writer whose words we have just quoted here likens the fall of the leaf to the close of existence, but for ourselves we prefer rather to regard it as the advent of that natural slumber which is as needful for the tree and for the plant, as for animals

* *Frank Forester's American Field Sports*, by Henry Wm. Herbert, 1852, Vol. i., p. 264.

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or for men—and the casting off of the foliage will thus represent the putting off the garments of the day preparatory to taking that rest which night was intended by Nature to bring, with some exceptions, to all animated nature.

Of the sleep of plants we have spoken elsewhere, and hibernation or winter sleep, which as we know is sometimes found to occur in animals as well as in plants, is merely another, though much more prolonged form of sleep, during which the vital energies of deciduous vegetation are in a state of rest, preparatory for the great awakening of Nature's functions which occurs upon the advent of spring. This period of rest is, as we believe, both necessary and common to vegetation of every description and locality, though to outward appearance such may not always be evident; the casting off of foliage in like manner is common to all sorts of trees and plants, though as in the case of pines, and other evergreens, it is effected so gradually that it is the dead pine needles that cover the ground beneath these trees which alone convince the ordinary observer that the foliage falls at all. So, in the great equatorial forests, the same phenomena occur; leaves are continually throughout the year, both falling and sprouting, and there can be no doubt that a period of rest takes place there also, though the exact nature of it may not be apparent, nor well understood. In tropical countries however, as we have before pointed out, it is a well ascertained fact that the rest of plants is often produced by intense solar heat, very much in the same way as it is produced in temperate regions by cold; leaves fall, and growth is arrested, exactly as it is by winter—and

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the return of spring is there represented by the exuberant growth produced by the advent of the rainy season. In our next, or polar section, we hope to be able to cite numerous remarkable instances of the similarity of effects produced by the apparently opposite functions of great heat and great cold.

In connection with this question of the winter rest of plants, we may state that when trees or plants are introduced into the tropics from temperate regions, it is found that their constitution suffers severely from the loss of this period of repose, and if they do not actually die, they dwindle and refuse any longer to ripen their fruits. This was observed in the case of peaches, cherries, and other European fruit trees, introduced into Ceylon—they grew freely, but became evergreen, and then, as if exhausted by perennial excitement, ceased to produce. A similar failure followed the introduction of the vine into the gardens of Jaffna—here, however, a most interesting experiment was made to test the possibility of obtaining a season of rest by the agency of heat, instead of cold, and it succeeded perfectly.

Sir J. Emerson Tennent informs us that:—

"Mr. Dyke, the government agent in whose garden they grow, conceiving that the activity of the plants might be equally checked by exposing them to an extreme of warmth as by subjecting them to cold, tried with perfect success the experiment of laying bare the roots in the strongest heat of the sun. The circulation of the sap was thus arrested, the vines obtained the needful repose, and the grapes which before had fallen almost unformed from the tree, are now brought to thorough maturity, though inferior in flavour to those produced at home." *

* *Ceylon*, by Sir James Emerson Tennent, 1859. Vol. i, Ch. 3, p. 89.

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Similar results followed experiments made by Mr. Ballard of Bombay, to give the vine an artificial winter there, by exposing the roots of vines to the sun during the hot season. * The vine, however, as we know, is a plant capable of enduring almost any amount of heat, and so long as there is a dry season during which its roots can be exposed to intense drought, that seems to act upon it almost as effectually as if it were exposed to frost—the foliage falls and an artificial winter's rest is obtained, and thus it has been found to do fairly well in some of the oases of the Sahara, where these conditions are realized.

The object of the digression is to establish the point upon which we have insisted: namely, that the apparently opposite phenomena of heat and cold often produce very similar effects; and the results of the above experiments furnish us with a striking illustration of the fact, so that it will be unnecessary to dwell further upon it at present.

We have now passed in review all the leading phenomena of the great forest region of the temperate zone, and we shall endeavour to give a short account of man as an inhabitant of the forest, principally in connection with the red Indian tribes which formerly had their home in the North American forests.

Subsequent to the discovery of America the red Indians of the eastern forest region were necessarily the first tribes that came into intercourse with European adventurers, and at the time when the early expeditions were sent forth from England, France, and Spain, these peoples were found existing in large numbers

* See *The Transactions of the Agricultural and Horticultural Society of India*, Calcutta, 1850. Vol. i, p. 96.

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almost everywhere upon the Atlantic seaboard, as well as upon that of the Gulf of Mexico: and we believe that there are ample grounds for asserting that the first meeting of the whites with the Indians was of a friendly character—that is to say, that upon their first landing the strangers were almost invariably received by these children of Nature with hospitality and kindness; the best of everything that they possessed, in the way of food and articles of barter, being set before them. But as usual when the savage and the civilized man have met, it was not long before quarrels and hostilities arose, caused, as it is said, by the aggressive attitude assumed by the whites; and we feel bound to say that the evidence goes to show that the Spaniards were the greatest sinners in this respect; and that more than either the English or the French, their cruel and tyrannical conduct first laid the seeds of that antipathy of race which has never ceased to operate, with such disastrous results, up to the present time.

It is another melancholy feature in this case that the original policy given out to the world as *the object* of Spanish diplomacy, was the conversion of the heathen to the Christian religion. How this pious intention was carried out, let the history of the West Indies, and other places, tell!—Here especially, it is admitted by the Spanish historians themselves that the primitive races who were found inhabiting Cuba, San Domingo, and other islands, were a peculiarly mild and inoffensive set of beings: yet in the course of a comparatively few years, such were the extraordinary barbarities that were practised upon them, that the whole of these people, after being reduced to complete slavery, became extinct. In Mexico and Central America however, the

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natives were made of sterner stuff, and sanguinary battles were frequent.

Now in the case of the French in Canada, we feel bound to say that a generally humane and generous policy actuated their governors; and though there were wars and fightings, these things could not be helped, and were the natural results which follow all occupations of wild countries by Europeans, when they have to *govern* savage races; in this case also, great stir was made about "the conversion of the heathen" and so forth, and the country was inundated by monks and nuns of the different religious orders, who quarrelled fiercely among themselves for the love of God, and did their little best to render all other more practical government impossible—in fact a species of dual government existed, represented by the civil power on one side, and the ecclesiastical on the other: and between them, such a mess was made of the whole business that in many cases the colonists themselves were by no means sorry when the Naval and Military power of England compelled the surrender of the French forces, and so in 1761 completed the conquest of Canada.

Now in their dealings with the Indians the British were more practical; in their schemes of conquest there was less affectation of religious motives; just as they are doing now in Africa they desired simply to obtain new markets for their commerce, and to pre-empt waste lands upon which their superabundant population could settle. Our fathers had sense enough to see that the preposterous idea of combining conquest with missionary enterprise was bound to fail: for surely to come to a country, land in force upon its shores, erect forts, and seize upon its fairest provinces, is one of the least

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likely of all methods for inducing the conquered races to embrace a new religion, that can well be imagined. The policy of "*Bibles and Bullets*" is one of doubtful success everywhere. The subjugated people naturally regard the proud invader with fearsome and distrustful eyes, and are not at all likely at his dictation to cast away the prejudices and superstitions of their race, in favour of the new learning; it is only as time goes on, when the bitterness of defeat and the social hatreds of the past are forgotten, and when the natives realize that they can live in greater peace and quietness under the new regime than under the old, and can enjoy their acquired property in security, that a foundation is laid for that great universal missionary "the schoolmaster" to commence operations.

That is the policy of the British government in India: first to ensure order and respect for the rights of property, and leave opinions afterwards to settle themselves, with liberty of conscience to all.

We shall not weary our readers with long descriptions of American Indian life and history: these subjects have already been made the object of many portly volumes; we shall therefore confine our remarks upon this subject to a sketch of the red man as a dweller in the forest and the wilderness, in his capacity as a hunter and a warrior.

In the days of our childhood we can well remember the picturesque appearance of a band of these plumed and painted warriors who were brought over to London from the neighbourhood of the great lakes of Canada, to exhibit before a European audience their war dances, and songs of victory over the fallen enemy, whose scalps were exhibited hanging in a dried state

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from their head dresses; and a brave show these noble looking savages made, clad in all the panoply of paint and feathers, with their tomahawks and scalping knives, and war whoops.

In those days Fenimore Cooper's novels were eagerly read by every boy; and though these books must of course be regarded simply as romances, still in many respects they gave a very good, and often faithful account of the war tactics and habits of these ruthless savages, who by the time the British power was well established in America, had become the hereditary foes of all white men. The friendly Indians were simply those who, having received the only thing they understand or respect, namely a stern lesson of the power of England to compel them to respect the persons and property of the whites, now posed as "the children" of the great white chief: the settlers thus became their "white brothers."

Nearly all the leading incidents of the story told in each of Fenimore Cooper's novels, we may here remark, are founded upon historical fact, and most of the chiefs and Indian braves, whose exploits are recounted, are also drawn from real life—so is the character of his white hero "Leatherstocking," the forest ranger, and trapper.

We can have no doubt that this latter character is founded upon the history of Daniel Boone of Kentucky,* a celebrated Indian fighter and frontiersman who lived and flourished about 100 years ago—"Nathaniel Bumpo"† is in fact, an evident adaptation from the name of

* Born in Pennyslvania in 1734—died in 1820, aged 86; spent nearly all his life as a hunter and Indian fighter. Was the first white settler in Kentucky, which State he founded in 1754, the first band of white settlers being brought out there under his guidance.

† The name given by Cooper to the scout "Leatherstocking."

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Boone, used by Cooper for that of his principal hero.

Those of our readers who have read "The Last of the Mohicans" (which is generally accounted the best of Cooper's tales of the frontier), will doubtless at once recognize it. Now the Mohicans, an Indian tribe long since extinct, were a warlike and at one time a very troublesome people, who in former days inhabited a great part of the State of Connecticut and portions of the State of New York. The story of Colonel Munro, and his daughters Alice and Cora, are also adaptations from real life, the former being a Scotch officer in the service of George II., and who was the British Commander of Fort William Henry, in the State of New York, during the siege and sacking of that post by the French under Montcalm in 1757—and we have no doubt that the materials for the story of the girls are drawn from the historical accounts of the adventures which befell Jemima, the daughter of Daniel Boone, and two other girls, Betsy and Fanny Callaway, who were captured and carried off by Indians, on July 14, 1776, from Boonesborough in Kentucky, much as described in the pages of this novel. The Indians Sagamore, Chingatchcook, Uncas, * and Le Renard Subtile, are also all taken in the same way from real life, and were all celebrated Indian chiefs, who in their day were prominent warriors of various forest tribes.

It may be interesting to give a short retrospect of the Story of Cora, one of the heroines of "The Last of the Mohicans." Details which have come under our

* A Mohican Chief—and a friend of the white man, who died about 1686 and was buried near Norwich (Conn.), where a monument was erected to his memory by the Americans in 1842. (See Brit. Musm. Discourse delivered by Wm. Leete Stone, on the occasion of unveiling the monument, July 4th 1842, publ. at New York 1842, 12mo).

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notice in the course of our researches leave no doubt upon our mind that the character is drawn from that of Betsy Callaway, who was carried off from Boonesborough, as already mentioned, by a band of painted savages. She and the two other girls were, it seems, out in a canoe on the south Fork of the Kentucky river, at the time when they were surprised by an Indian war party, by whom they were at once carried off into the forest. These wily savages, foreseeing the probability of pursuit, according to their usual practice in such cases, compelled their unhappy captives to travel almost night and day, until they thought themselves beyond the reach of being overtaken, with the idea, no doubt, of holding these young women as hostages and as the wives of some of the tribe until they were ransomed by their friends; for the Indians were by that time fully alive to the commercial value of white captives, for whose ransom they were often able to extort large quantities of valuable trade goods of the kinds most useful to themselves, such as blankets, iron pots, kettles, hatchets, knives, fishing tackle, tobacco, and vermillion for painting their faces, etc., and even supplies of guns and ammunition. Well, the abduction of the girls was seen and reported to Boone almost immediately after its occurrence; and he at once set to work to organize a rescue party. Seven men quickly volunteered to act under Boone's orders, among whom were the lovers of the three girls. These hardy frontiersmen after following the trail of the captives for two nights and a day, came up with the savages, whom they completely surprised, and rushing in suddenly upon them, they scattered or slew the whole party before they could make any effective resistance

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or destroy their captives, with whom they returned in triumph to the Fort. It seems that the two younger girls had given themselves up for lost, but Betsy Callaway kept up her courage, continually telling the others she was sure they would be followed and rescued, and in order to mark the line of their flight, every now and again she broke off twigs from the bushes. This did not escape the keen eyes of her captors, who threatened her with the tomahawk if she was seen again to repeat the experiment; and they at once endeavoured to erase the trail thus given, by bending down, or breaking the branches, so as to make it look like the work of browsing deer; they also thenceforth compelled the girls to walk apart in the dense brushwood, and to walk along the beds of streams, where no tell-tale footsteps would be left to show where they had passed; but Betsy still managed to tear off strips from her dress and drop them unnoticed by her guards. Meanwhile the avenging whites who were following swiftly upon the trail, faithfully interpreted all these "signs of the wilderness." They saw the broken twigs; they detected the attempted imposition of the Indian artifice to make it look as if done by deer; they deciphered the footsteps on the ground; and no doubt found and identified the bits of torn dress. Fortunately in such cases, it is impossible for a man to pass without leaving some mark; his footmarks will leave their imprint in soft places, or upon dead leaves; and the place where they enter the streams will be marked in the same way: so will the points of exit; a clever scout like Daniel Boone would read these things as plainly as if they were printed handbills attached to the trees; and his knowledge of the tribe

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whose war party they were following would reveal to him the general direction they would be sure to follow to regain the villages of their nation; also the tribe they belonged to would be disclosed by certain little signs known to experienced scouts, such as the peculiar markings of their foot-gear * (as shown in the footprints), their particular mode of marching, and numerous other points, which their intimate knowledge of Indians would make them aware of; then the fact of dividing the party would make it easier to form an almost exact estimate of the number of warriors it contained; their footmarks on the different trails would be certain to show this. Though Indian war parties generally endeavour to conceal these details by walking in Indian file and causing each man carefully planting his feet in the footmarks of the man in front. We may be sure all these things, and more, were duly noted by this experienced scout and his white companions, long before the critical moment came when they would suddenly jump upon, and destroy the sleeping Indian war party (we can see it all nearly as clearly as if we had been there in person), for even Indians must rest: moreover, the girls would not be able to stand the strain, and their strength would become exhausted; that would force the Indians either to kill them, or else carry them; if they did the first, the valuable captive was lost and with her the amount of her ransom; we may be pretty sure therefore, that rude litters were con-

* Almost every Indian tribe, even to this day, has its own peculiar pattern for moccassins, snow-shoes, and other articles of daily wear. So again, their huts, method of making fires, camping, etc., all have their peculiar form so that it was easy for a skilled woodsman to recognise the particular tribe they represented. We could cite numerous instances of this, did time and space permit.

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structed upon which the exhausted captives were borne along in the way that it was usual for Indians to carry off wounded men belonging to their tribe; but the cutting of the sticks and work of manufacturing these things could not be done without leaving a mark: the Indians could not stop to erase every mark made, because if they did, it would delay the march too long; moreover, the marks of erasure would still be visible, and in either case the pursuers would at once see what had been done, and know that the girls' lives would be safe, as long as the pursuit remained undetected. It was by no means an unknown thing in the Indian country for pursuits of this kind to be kept up even for weeks, over hundreds of miles of country, and for the rescue to be triumphantly effected after all.

In this case, as it seems, the pursuit was sharp and brief, and the rescue nobly and ably effected. Finally the story ends in the usual way, the three lovers and rescuers duly marry their respective sweethearts: Samuel Henderson married Betsy Callaway, John Holder married Fanny Callaway, and Flanders Callaway (no doubt a brother of theirs) married Jemima Boone; and let us hope they all lived happily ever afterwards, as true lovers are always supposed to do.

As regards the ability of these frontier scouts, and of the British officer in the conduct of wars with savages of different kinds, a French general has (perhaps unconsciously) paid our countrymen a high compliment; for in a recent military work of considerable authority which he has published, we find that all the instances quoted, as to the best methods of fighting savages, are exclusively drawn from British experi-

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ences, thus showing that the French, in this respect at least, admit the superior tactical knowledge of the British over any other nation.* Then again, hear the evidence of an American bishop, speaking upon the respective merits of the British and American systems of dealing with the red Indians:

"On one side of the line (*i.e.*, the British and American boundary line, Lat. 49° N.) is a nation" (the Americans, as they call themselves) "that has spent 500 millions of dollars in Indian wars. A people who have not 100 miles between the Atlantic and the Pacific which has not been the scene of an Indian massacre—a government that has not passed 20 years without an Indian war, and which celebrates its centenary (1876) by another bloody Indian war. On the other side of the line are the same dominant Anglo-Saxon race (the British) and the same heathen. They have not spent one dollar in Indian wars, and have had no Indian massacres." †

The Right Reverend prelate does us too much honour; but it is not our place, in these pages, to enter into matters of historical controversy; we could not therefore think of being so rude as to contradict him. Moreover the conspicuous success with which the British have managed their Indian wars throughout their North American possessions is notorious, and it is worth noting that the official recognition of the Native Tribes in our public documents is always as "The Indian Subjects of Her Majesty," and by no means as indi-

* See "*Stratégie et grande tactique des derniers guerres*, par le General Pierron, 2 Vols 8vo, Paris, 1887.—*Travaux et fortifications contre les tribus sauvages*, Vol. i., pp. 313 to 322.

† Extract from a letter addressed in 1876 to the President of the United States by Bishop H. B. Whipple of Minnesota—quoted in the Introduction (by Mr. William Blackmore) to *The Hunting Grounds of the Great West*, by Colonel Richd. S. Dodge, U.S.A., pp. xlii and xliii.

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gent mendicants, who form a burden upon the State. Even among the Indians on Bishop Whipple's side of the line, it used to be a good plan for Englishmen to let the U.S. Indians know, when they met them, who and what they are: they should make themselves known as "a King George's man," and they will not be the less well received in consequence. "King George" of England, * is a name still held in reverence and regard amongst the whole of the Indian tribes near the British frontier, and indeed throughout America (though it may please some English radicals of the present day to speak slightingly of the kings of that name); forgetful that the foundations of the British Empire were firmly laid in those reigns under the stress of wars and difficulties of which the modern Briton can scarcely form an idea.

What we now enjoy in comparative peace and quietness, our forefathers fought and paid for, both in blood and treasure: yet we hear it continually thrown up to us that in those days taxes were high, and the laws draconic, and so forth; if they were, they were higher and severer elsewhere, while the invaders' troops marched from time to time over the soil of every European country, our own alone excepted; to King George and his advisers we owe our immunity from invasion, and much of our subsequent greatness. These things ought never to be forgotten when we speak of the sovereigns of the House of Hanover.

But to return to the subject of the forest Indians;

* The name of King George III. appears on the medals still treasured by the Indian tribes, which they produce with great ceremony when a "King George's man" is presented to them. We have seen numbers of them. They are large pieces quite the size of a crown-piece with a swivel attached by which they can be suspended round the neck.

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even more than their brethren of the plains, they were adepts in all the arts of Indian surprise and other war crafts. When a party of Indians on the war path passed through the forest it was generally by a regular beaten trail, such as existed here and there throughout almost every considerable district of the American backwoods from times of unknown antiquity. These trails were generally made use of by all travelling parties of Indians, whether out as a hunting or a war party, at all events until the neighbourhood of enemies was known to be not far distant. They were exceedingly narrow paths, as a rule not more than nine inches or a foot in width at the ground, and these forest warriors always marched in single, or Indian file, one behind the other, carefully stepping as much as possible in each other's footsteps. In this way the number of the party was more or less concealed; to ascertain the strength of a party, it was necessary to find where they had camped, it was then possible to compute to a considerable nicety of how many persons it was composed, and whether they were merely a hunting party, or out upon the war path.

In marching the Indians (so far as our experience of modern specimens of the race may go), generally walked differently to a white man, the toe being turned inwards, instead of outwards, as in the latter case. This gave a peculiar character to a man's trail, and though both the red man and the white often wore moccassins, this difference still generally gave a clue as to the colour of the traveller's skin.

These forest paths made by the Indians were always travelled over sufficiently to keep them open, and were distinctly traceable along the ground; they led from

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most of the important points in the forest, as for instance from village to village, and indicated the way to springs, to fords upon rivers, or the best line of portage for goods, round rapids or across a divide, from one lake or river to the next. Some of these trails, we understand, are even now traceable in the oldest settled portions of the country, where the woods have not yet been wholly cleared. Parts of that which was used by the whites, 250 years ago, between Plymouth and Boston, for example, is still clearly discernible. *

Almost similar paths conduct the traveller, we may here observe, through nearly every part of Africa; and African caravans from time immemorial have adopted the Indian file system of single individuals following each other, as the order of their march, even when crossing wide and level plains. So in Hindustan; native paths lead through the forest and jungle, and through the defiles of the hill country, almost throughout the entire length and breadth of India. In the early days of American settlements it was in the dense bush at the edge of these paths that parties of ambushed savages laid in wait for their prey, and many an unfortunate white has been suddenly "jumped" by the Indians, when he thought danger and death far removed from him. The first intimation of the disaster that reached his friends, was generally the fact of his body being found scalped, and frightfully mutilated, along the side of one of these paths; in this respect forest Indians have always proved far more dangerous and difficult to deal with than the plains Indians. The densest forest was to them at once a home and a

* See *Narrative and Critical History of America*, Edited by Justin Winsor, Librarian of Harvard University, 1889, Vol. i., p. 294.

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fortress. Nothing passed unnoticed by their keen eyes, as they moved through its shadows; and an Indian could no more get lost in its trackless depths than a Londoner could in his maze of streets; while to the whites the forest was one vast ambush from which at any moment Indian war parties were liable to issue forth to attack and destroy.

There was usually no "declaration of war," but Indian raids were very generally heralded by the commission of isolated outrages upon single individuals, and a marked increase in the arrogant demeanour among the neighbouring tribes. In dealings with Orientals and other native races these symptoms are, as we have already remarked, the almost certain indication of serious impending trouble, which if not at once met with firmness, and a display of force, the next thing generally is a tribal war—and in America this usually meant a descent by large bodies of Indians upon the scattered settlements, which were ravaged with fire and the tomahawk. Such raids generally came as a "bolt out of the blue," Mr. Roosevelt gives a good description of one of these scenes:

"Without warning, and unseen until the moment they dealt the death stroke, they emerged from their forest fastnesses; the horror caused being heightened no less by the mystery that shrouded them, than by the dreadful nature of their ravages. Wrapped in the mantle of the unknown; appalling by their craft, their ferocity, and cruelty, they seemed to the white settlers, devils, not men. No one could say with certainty whence they came, nor of what tribe they were; and when they had finished their dreadful work they retired into the wilderness, that closed over their trail as the waves of the ocean close in the wake of a ship." *

* *The Winning of the West*, by Theodore Roosevelt, 1889, Vol. i, p. 82.

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In passing along trails leading through the woods from village to village, or as it got dusk, in camps or even close to the settlements, the almost noiseless "whiz" of an arrow, might at any moment during disturbed times be the only warning accompanying the infliction of a perhaps mortal wound dealt by an unseen hand. In the early days of colonial settlement, the bow and arrow was of course the only weapon employed by the Indians, many of whom were exceedingly skilful archers. It is said, though we ourselves believe it to be an exaggeration, that in the old buffalo hunting days, an Indian has been known to drive an arrow right through this immense animal, and out on the other side. There were two distinct kinds of arrows in use by the Indians, one intended for hunting purposes, and the other for war: that for hunting was generally plain and unbarbed, and firmly fixed in its shaft; while that for use in war is barbed like a fish hook, so that once in, it cannot be extracted without a serious surgical operation; the head is also but lightly attached to the shaft, so that if an attempt is made to withdraw it, it comes off and remains in the wound. These arrows therefore, as may be supposed, produce deep incised wounds of a very serious, and even deadly character. When the arrow inflicted mere flesh wounds of the external surface, or of the extremities, the method of extraction in general use among the Indians was to push it entirely through the limb; the head was then cut off, and the shaft thus became easily withdrawn by the way it entered.

Such were the difficulties and dangers with which our first colonists in America were constantly threatened: they were of a character to try men's courage to the

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utmost, and required a person to be of iron nerve to live unmoved in the midst of them. For a man never could tell, when he went out for the day, whether he would return home at night in safety; nor could he be certain that on his return he might not find his log cabin a heap of ashes and his wife and children mutilated corpses. It therefore became quite a common thing to drink to the safety of a man's scalp upon the frontier, and the usual form of toast was, "The hair on your head; and long may it wave there"—in allusion of course to the possibility of its being any day "lifted." Nevertheless there were not wanting plenty of daring spirits who preferred the frontier to more settled districts, in spite of the chances of sudden death, and also those of being carried off and put to death by the slow ordeal of torture, which followed almost as a matter of course upon capture when the Indians were excited by losses of members of their tribe in action, or any other uncommon event. Some of these men lived in the depths of the wilderness, several days' march in advance of the regular recognised frontier, and thus lived all their days with their lives in their hands; of these daring pioneers of course the majority in the end met their deaths at the hands of the Indians. Few indeed lived to die in their beds at their natural term of existence: yet some few successfully combatted all dangers, and passed their days in almost continual warfare. One of these was the celebrated Daniel Boone of whom we have already spoken. He was a tall, spare, sinewy man, with eyes like an eagle's, and muscles that never tired; and he lived, as we have said, for 86 years, a hunter and Indian fighter to the end of his days, and died in his bed surrounded by friends and family after all.

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As for the Indians themselves, they were deeply and unalterably attached to their wild life in the woods, and were generally, notwithstanding intertribal wars and other troubles, a very happy and contented people. They lived almost wholly upon the proceeds of the chase; but at times the squaws sowed small crops of beans and maize where open spaces were to be found: fishing in the lakes and streams was also very generally carried on. So far as we can learn, there is not a single instance on record of one of them leaving his nomadic form of existence, and adopting the life of the white settlers of his own accord. But the instances of whites who have become Indians are too numerous to mention—they might be counted literally by thousands. A practice also gradually grew up among the Indians of adopting white captives, both male and female, as members of their tribe, to make up losses which had been incurred in battle.

At first there can be no doubt the captives usually had a bad time of it, and their lives as it were hung by a thread. But when the first frantic outburst of fury which followed a battle was over, and the slaughter of a sufficient hecatomb of victims to atone for the Indian losses had glutted their thirst for vengeance, the Indians usually spared the remaining captives, who were generally mostly women and children; and the survivors were at first treated as servants, or even as slaves. But by degrees, as a better feeling prevailed, they were regularly adopted as members of the tribe. From thenceforth they could live in safety, and were rarely or never molested in any way, the only bar placed upon their complete liberty being such precautions as were deemed neces-

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sary to prevent their escape back to the settlements. But the great distance to which they were generally carried off to prevent the likelihood of pursuit or recapture was generally in itself sufficient to render escape out of the question: for several hundred miles of a wilderness of almost impassable forest was often placed between them and the homes of their fathers.

We may mention a few notable instances of this adoption of strangers into the tribes, to illustrate what we have said above—for independently of the adoption of numbers of captives in the manner described, it became the practice of many of the tribes to elect certain whites (who had done a good turn to the Indians, and who had treated them with friendliness and consideration, and in whose honour the Indians believed they could trust) as political or war chiefs of the clan. One of the most notable of these was Sir William Johnson, who was elected paramount chief of the Mohawks in 1746; another was Dr. Cadwallader Colden, Surveyor General, and afterwards Lieutenant Governor of the colony of New York, who was also adopted by the Mohawk tribe. Then there was one of the Dukes of Northumberland, who served as Lord Percy in the American revolutionary war, who was created chief of "The Six Nations." Washington Irving was also adopted a member of the Huron nation, and the late General Porter, U.S.A., was long a chief of the Senecas. *

In the case of adopted white captives therefore, from the moment of their adoption into the tribal community they were treated with every degree of friendly con-

* *The Life and Times of Sir Wm. Johnson*, by W. L. Stone, publd. at Albany, 1865, Vol. i, p. 541. (Appendix No. 1).

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sideration, and they would be in no way worse off than any other inhabitant of the Indian village, whatever the colour of his skin. That being so many of these unhappy people thus in time became not only reconciled to their lot, but deeply attached to their red comrades.

A memorable instance where this was clearly proved, occurred after the relief of Fort Pitt by General Bouquet, which was closely besieged by several Indian tribes in 1763. This able officer, * who was of Swiss extraction, followed up his success the following season by a demand for the delivery of all white captives, young or old, living among the Indians either as prisoners or as adopted members of the tribes. This occurred in October, 1764, and he gave them twelve days to hand them over to him at Fort Pitt. Every effort was made by the Indians to evade the latter part of these conditions, but Bouquet was resolute and enforced his demand as the first condition of a truce. The compliance with it in many cases led to incidents of a touching and highly dramatic character. Some of these people came to Bouquet's camp with full as much reluctance as that which was felt by the Indians who gave them up. Indeed several of them could only be secured by being bound and guarded. † Many others clung to their

* General Henry Bouquet, born in the Canton of Berne, Switzerland, 1719, was in the Dutch service, and afterwards entered the British service in America. He was sent to relieve Fort Pitt (formerly Fort Duquesne) 1763, and so completely defeated the Indians (Aug. 5) that they abandoned the blockade. In 1764 he reduced the Indian tribes on the Ohio to submission—and 1765 died of yellow fever, at Pensacola, Florida.

† See *Narrative and Critical History of America*, by Justin Winsor, Librarian of Harvard University, 1889, Vol. i, pp. 290 and 292.—Also *The History of the Conspiracy of Pontiac*, by Francis Parkman, 1885, Vol. ii., p. 238.

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Indian friends at the last, with bitter tears and manifestations of heartfelt grief on both sides; they positively refused to return to the settlements or to acknowledge their nearest kin, some of whom stood by endeavouring to regain their affections by every means in their power, until finally they had to be separated from their red companions by force. In the cases of children, who retained but a faint remembrance of home, these cases were very numerous, and the little creatures abundantly testified by their shrieks and struggles their unwillingness to part with their Indian foster-parents.

We think a description of this scene, given by an eye-witness, is quite worthy of being reproduced in confirmation of this remarkable historical incident:

"And here" (he says) "I enter on a scene which language can but weakly describe. I mean the arrival of the prisoners in camp, where were to be seen fathers and mothers recognizing and clasping their long lost babes: husbands hanging round the necks of newly recovered wives," etc., etc. "The Indians too, as if wholly forgetting their usual savageness, bore a capital part in heightening this most affecting scene. They delivered up their beloved captives with the utmost reluctance, shed torrents of tears over them, recommending them to the care and protection of the commanding officer. Their regard continued all the time they remained in camp. They visited them from day to day, and brought corn, skins, and horses, and other presents with all the marks of the most sincere and tender affection. When the army marched, they obtained leave to accompany them, and employed themselves in hunting for them on the road. A young Mingo carried this still further, and gave an instance of his love which would make a figure, even in romance. A young woman of Virginia was among the captives, whom he called his wife; and against all remonstrances of the imminent danger to which he exposed himself by ap-

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pearing on the frontier he persisted in following her. Even some grown persons (among the captives) showed an unwillingness to return. The Shawanes were obliged to bind several of their prisoners to force them along to camp, and some women who had been delivered up, afterwards found means to escape and run back to the Indian town. Some who could not escape, clung to their savage acquaintances at parting, and continued many days in bitter lamentations, even refusing sustenance." *

This shows beyond the possibility of mistake that the Indians were by no means destitute of the finer feelings of humanity, and were possessed in very strong degree of sincere affection for their companions of the white race. It also proves how thoroughly the fascinations of the Wilderness had enchained these supposed unhappy and unfortunate captives, who had become almost more Indian than the Indians themselves.

The only parallel to it is to be found among the English settlers resident in Ireland. "beyond the pale" during the Tudor period, some of whom, in like manner, had adopted the native Irish ways, and like the white Indians had become "Hiberniores ipsis Hibernis."

In order to correct misconceptions, and put this matter in its true light therefore, we have been specially careful to mention the case of the "White Indians" of America, because it shows in the clearest manner that the native red man was not, as some have maintained, altogether a fiend in human shape and entirely dead to the feelings of humanity; for notwithstanding the many drawbacks of the Indian life, Indian kindness and hospitality constantly won over to itself very many

* An Historical Account of the Expedition against the Ohio Indians in 1764 under command of Henry Bouquet, now Brigadier-General in America, publ. Philadelphia 1766, pp. 26 to 29.

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white adherents, both among the British and the French. Many of these "coureurs des bois," as they were called among the latter, were to all intents and purposes, Indians. In a recent work, compiled from the most authentic sources, the following passage occurs respecting white captives made during the French regime in Canada:

"It was supposed for a long while," says one of the officers of the colony, "that to civilize the savages it was necessary to bring them in contact with the French. We have every reason to recognise the fact that we were mistaken. Those who have come in contact with us, have not become French; while the French who frequent the wilds have become savages." *

Exactly as in the British cases already noticed, when demands for the surrender of captives were able to be enforced, the French found that "prisoners held by the Indians often concealed themselves rather than return to civilized life, when their surrender was provided for by a treaty of peace." †

It is therefore clear that in their home life the Indians were not so barbarous as has been generally believed. Many whites who had married among them were sincerely attached to their red wives and half-breed families. Then again there are innumerable instances of devotion shown by Indian women to their white lovers; in many cases they have faced the bitter enmity of their own people for their fidelity to the interests of their pale-faced partners, and in some instances even death itself, rather than betray those they loved. A few of these Indian girls, chosen from the different neighbouring tribes living about a fort or frontier

* *Narrative and Critical History of America*, by Justin Winsor, Librarian of the Harvard University, 1889, Vol. v, p. 4.

† *Ibid.*, Vol. v, p. 4.

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post, therefore, were generally a valuable protection to the place. It is generally better policy to select them from different tribes than from any one tribe, as experience shows that they then, partly through jealousy and partly through distrust, keep each other in order. They also keep their partners posted about what is going on among the surrounding tribes, and thus the whites were certain to hear through them, of any effervescence or secret conspiracies among the Indians. They were then able to take timely precautions which has saved many a frontier post from destruction. There is a romantic history attached to one of these cases which we should wish to relate on account of the high political importance which the circumstance assumed, which was no less than the preservation of the important garrison and frontier post of Detroit, during the great Indian conspiracy organized by Pontiac, principal war chief of the Ottawas, in May 1763. This movement was by far the most widespread and serious of any of the combinations made by the Indian tribes against the pale-faces in the history of North America, and it required the whole force of the British power in her Canadian and other American possessions to subdue it. Many detached forts and small garrisons did in fact succumb, and their garrisons were in many cases exterminated to the last man. Now Detroit was the most important of them all and, like the city of Londonderry in the Irish wars of 1688—90, it formed the key to the whole position in the West. The modern city of Detroit, which now stands upon the site of this once celebrated fort, is as we know, situated upon the river of that name which forms the outlet from Lake Huron, via Lake St. Clair, into Lake Erie.

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In 1763, the garrison consisted of about eight officers and 120 regular soldiers of the 80th Regiment * under the command of Major Gladwin, a man of fearless courage; † some 40 fur-traders, and other employés, completed the strength of the garrison; and if there be any truth in tradition, it seems that in the Pottawattamie village hard by, there lived a girl of the Ojibwa tribe, who it is said could boast a far larger share of beauty than was common in the wigwams. She was one of the wild beauties of the forest and was known to the whites as "Catherine." This girl had become devotedly attached to the British Commander. It so happened on the 6th of May 1763, she came to the fort, and Gladwin on seeing her was at once struck by something unusual in her appearance and manner. What was the matter? But though he pressed her to disclose what was weighing upon her mind, for a long time the girl remained silent; but at last she took courage and made a clean breast of it. "To-morrow (said she) Pontiac will come to the Fort with 60 of his chiefs; each will be armed with a gun cut short, and hidden under his blanket. Pontiac will demand to hold a council, and after he has delivered his speech will offer a peace-belt of wampum. This will be the signal! Every Englishman will be killed!!" §

* See *History of the United States of America*, by George Bancroft, 1876, Vol. iii, p. 279.

† Fort Detroit at this time was a large stockade about 20 feet high, and 1200 yards in circumference, enclosing perhaps 80 houses; it had, however, only two 6 pounders and one 3 pounder gun, with 3 mortars of little use (Bancroft's History, 1876, Vol. iii, p. 377).

§ *The Conspiracy of Pontiac*, by Francis Parkman (the younger), 1885, Vol. i., p. 216. (Extract letter, from H. H. Schoolcraft, containing the account given from the lips of the interpreter, Henry Connor). See also, Carvor's Travels, p. 155, publ. London, 1778.

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The night passed without incident: nothing occurred to create a suspicion of foul play; but of course Gladwin and his officers were all on the alert, intently watching the course of events; further questioning of the girl had elicited that next day the Indians were to assemble, ostensibly to play a game of ball, something resembling our "Hockey," which used in former times to be a favourite game among the Indians. Catlin, in his "American Indians" gives a full description of it. At the hour indicated many warriors were seen stalking towards the fort, wrapped in their blankets. Never had there been a moment when the steady stoical "sang-froid" of the British officer was more severely tried, or when calmness and judgment were of greater moment. Inside the fort, the whole garrison was drawn up under arms, and the soldiers awaited the result with that splendid courage and calmness which has always been a characteristic of British troops.

Gladwin ordered that Pontiac and his warriors were all to be admitted, according to the ordinary way in time of peace, and as if nothing unusual had occurred; and at 10 o'clock, the great war chief duly made his appearance, accompanied by his treacherous followers, all closely wrapped in coloured blankets.

There is nothing out of the common in this: it is the usual practice of Indians when attending a council, which we have ourselves witnessed on more than one occasion. Each man wrapped in his blanket just in this way, files in silent and dignified, and takes his seat without a word being spoken; and on this occasion it seems, they rigidly adhered to the conventional custom, which both before and since had always been observed.

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Pontiac's men, we are told, were all tall, strong, stately warriors, of peculiarly dignified aspect; but as Pontiac entered, it is said, "he started, and a deep ejaculation half escaped him," for at a glance he saw that his plot was detected, and doomed to failure; for on either side stood ranks of soldiers, and hedges of glittering steel. Pontiac and his chiefs, however, managed to maintain their composure, and filed into the audience chamber in silence, their rigid muscles betraying no sign of outward emotion; there they found Gladwin with several of his officers, seated, and waiting to receive them: but as the observant chiefs did not fail to note, all were fully armed with swords and pistols. Pontiac, it would seem, was the first to break the silence. "Why (said he), do I see so many of my father's young men standing in the street with their guns?" Gladwin haughtily replied that he had ordered the soldiers under arms for exercise and discipline; and after some demur the chief at length sat down. The customary pause ensued, and then Pontiac rose to speak, holding in his hand the wampum belt that was to give the fatal signal. He began by professing strong attachment to the English: "he had come," he said, "to smoke the pipe of peace, and to brighten the chain of friendship."—Gladwin and his officers watched him with unruffled composure: and at one moment Pontiac is said to have raised the belt, as if actually about to give the signal of attack; at this instant Gladwin is alleged to have slightly signed with his head: the sudden clash of arms resounded from the passage, while the roll of the drums, beating the charge, filled the council chamber with their din. Pontiac stood as one confounded, and some of the

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accounts say that Gladwin, rising from his seat, went over, and drawing back the chief's blanket, exposed the hidden gun, and informing him that all was known, sternly rebuked him for his treachery.

Other accounts say that the commandant (and this seems to be the more correct version of the story), not wishing to force a rupture, remained motionless, awaiting with unflinching hardihood to see what would come next; while Pontiac in confusion and amazement, soon sat down, perplexed and speechless. Gladwin then arose and, in a brief reply, assured the chiefs of his continued desire for friendship, but at the same time he sternly menaced them with swift and ample vengeance, upon the occurrence of the first act of aggression on their parts. And so the council ended, and the baffled savages withdrew, completely non-plussed at the untoward turn the affair had taken. *

The military questions involved in the defence of the frontier against the forest Indians, which had to be encountered by our great-grandfathers in America, were of the most difficult and perplexing nature. But both the British and the French (while their colonial power in Canada lasted) endeavoured to meet them in a similar way—namely, by the erection of small forts garrisoned by feeble detachments of troops, located at important strategic points, widely separated from each other by an expanse of wild country, about which very little was known. In the Hudson Bay Territory, and in British Columbia where the tribes were generally friendly, this system has been maintained with considerable success, till quite recent days: indeed it still

* See (among other authorities) *History of the Conspiracy of Pontiac*, by Francis Parkman, 1885, Vol. i, pp. 216—227.

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continues to be so now, in the barren grounds of Northern Canada, without any organic change of system. We need hardly advert to the very serious objections to which such tactics are exposed. The same system was however adopted and followed by the French (probably more or less upon the lines observed in America a century before), during the earlier period of their occupation of Algeria, but it was there found so disastrous in its results, that this system (vicious above all in a plains country) has since been entirely given up, except at a few points where reinforcements could be pushed rapidly forward, in case of need, at short notice. The system of keeping considerable forces together at a few important points, has in fact in modern tactics, entirely superseded the old plan (and very rightly so, in these days) of scattering them in detachments over a wide extent of country, in a chain of weak posts, each of which was liable to be cut off in detail before help could reach it.

In a great forest country, however, the movements of a large force, accompanied by its necessary supplies and munitions, are attended with almost insuperable difficulties. We have ample evidence of that in the disastrous expedition of General Braddock against the French garrison of Fort Duquesne, at the confluence of the Ohio and Monegahela Rivers, in 1755.* The expense and toil of cutting roads through the forest; the crossing of streams and swamps; and transporting everything for a great part of the way upon the backs of pack horses, was found to be enormous. It was, however, not on this account that this fatal expedition miscarried, with overwhelming loss, and great military disgrace;

* The place was finally wrested from the French, Nov. 28, 1758.

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but the history of this serious defeat exhibits in the clearest way all these transport troubles to which we have adverted: and it also illustrates in terms which are not to be mistaken the disadvantages under which regular troops fight, especially when trained only to warfare in the open, when called upon to encounter a savage and crafty foe hidden in the dense thickets of a great forest *—and as such we respectfully commend the eventful history of this expedition to the study of our military friends. We do so because it is a subject never alluded to in our military histories; and we must remember that *defeats* are sometimes more instructive than victories from an historical point of view.

In the days of our ancestors, a century and a half ago, with their weak forces and small resources, the problem of how to hold their ground against Indian forays was surrounded by difficulties which at present can hardly be realized; at every point upon the frontier there was an urgent call for protection, with but very scanty means of meeting it; the most that could be done was in general to furnish a small party of 15 or 20 men under the command of an ensign, or a lieutenant, to hold a blockhouse, or stockade, which was usually erected on the head waters of some stream, or other such point, which was supposed to guard the avenue to far distant wilds. From these places fur traders and other persons employed in trafficking with the savages, took their departure into the wilderness upon their arduous and dangerous expeditions, which sometimes lasted for years. The communications with

* See *History of Braddock's Expedition against Fort Duquesne in* 1755, by Winthrop Sargent, Philadelphia 1856.

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the settlements were maintained by narrow trails, such as have been already described, leading through the forest, along which trains of heavily laden pack horses carried the necessary supplies and trade goods (for most of these places were Indian trading-posts as well as forts), and for a long time they formed the pioneer depôts which were afterwards the nucleus of flourishing settlements. * Here these small detachments and these young officers in the early colonial days were frequently immured for long periods of time, buried in the Wilderness, with little or no supervision by superior officers; and if abuses sometimes crept in, if discipline became lax, if these frontier posts were often inefficiently guarded, it was not to be wondered at, even though such results were only too frequently the prelude to the most fatal and deplorable disasters. Every movement was watched by the keen eyes of stealthy savages, and ample experience showed that "the intelligence department" was much more quickly and efficiently worked by the red-skins than by the pale-faces. News always permeated through the forest most quickly among the Indians; and in the frequent border wars these advanced posts were in consequence often cut off to a man, even before the intelligence of their being in danger could reach the settlements.

These posts, however, had to be maintained, because the prosperity of the various frontier towns was mainly dependent upon the inland trade with the Indians to the westward. In quiet times, however, men of sporting tastes could from these forts indulge in their favourite pastime, almost to their hearts' content; there was

* See some observations upon ancient forest trails in *Narrative and Critical History of America*, Edited by Justin Winsor, 1889, Vol. i, p. 294.

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often literally almost no limit to the supplies of game of every kind, both of fur and feather: splendid sport with rod and line was also to be had at their very doors, without trouble or expense, such as the modern angler would now-a-days deem to be altogether fabulous. *

Let us take for instance the case of this very place, Fort Detroit, whose history has been already selected as furnishing a picturesque and important incident in Indian frontier annals; and make a brief retrospect of its famous past from a sportsman's point of view. Its position, as a glance at the map will show, was a noble one: the old fort stood upon the very bank of the Detroit River, some seven miles below its point of exit from Lake St. Clair; and the American historian Bancroft thus speaks of it: "It was," he says,

"the largest and most important of the North Western settlements. The deep, majestic river, more than half-a-mile wide, carrying its vast flood calmly and noiselessly, imparted grandeur to a country whose meadows and plains—festooned with wild vines, woodlands, brooks and fountains—were so mingled together as to leave nothing to desire. The forests were a natural park, stocked with buffaloes, deer, quails, partridges, and wild turkeys. Wild fowl of delicious flavour hovered along its streams, which yielded an astonishing variety of fish, especially white fish, the richest and most luscious of them all. Every luxury of the table might be enjoyed at the sole expense of labour (for gardens, it seems, yielded splendid crops of every kind), and from its battlements it commanded a noble panorama embracing a wide prospect for 9 miles, above and below." †

* See our section on "Fishing" for further accounts of the sport still to be had in some of these wild retreats.

† *History of the United States*, by George Bancroft, 1876, Vol. iii, p. 376.

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Now in the olden day the Detroit River was a celebrated "duck pass" (in sporting phraseology) where countless myriads of wild fowl passed up and down to and from their feeding grounds, along the margins of Lake St. Clair, which though it may look a small place upon a map, is in reality a sheet of water 29 miles long, by nearly as much in width. It is however shallow, and a canal has of late years had to be dredged to 16 feet in depth for the convenience of shipping. Water weeds therefore flourished and there was a peculiar aquatic plant which grew in its shallows (*Zizania Aquatica* or "Canada Rice") * which was greedily sought after by wild fowl, and which attracted innumerable flocks to the locality to feed upon it—more than that, not so very far to the southwards of the embouchure of the St. Clair into Lake Erie, were some of the most celebrated wildfowling grounds in the interior of North America, upon the swampy margins of these great lakes. We hope to be able to say something more upon this subject in our section upon Wild Fowl, but must defer any further remarks upon it until another opportunity.

Our object, we need hardly say, in referring to sporting matters at present was to make good our assertion as to the magnificence of the sporting quarters in the midst of which many of these western frontier posts were planted; given a quiet time, if a man could

* This invaluable game plant, the Wild, or Canada Rice, grows in N. America in shallow waters from Canada to Florida, occasionally attaining a length of 9 feet. It is a hardy annual, producing a very good grain, which attracts aquatic fowl of every description, and which was formerly collected by the Indian tribes and made into a species of bread. It is however as a food for water birds that this plant is so valuable—the only objection to it is that it stops up waterways, and thus acts as an impediment to drainage and navigation.

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make friends of some of the local Indians; though there may have been drawbacks in the way of "no society," there were other attractions which made many of our forefathers prefer the forest to the city.

Now as regards the rivers and great waterways, which in a boundless tree-covered region, form (as the late Mr. Parkman has so well expressed it) "the liquid highways of the forest," * we feel bound to say a few words before we close this section. We imagine the phrase itself to be one of those beautiful figures of speech, so common in the picturesque oratory of the Indians, when describing the glories of their forest homes: but however that may be (for Mr. Parkman himself was a master of descriptive narrative), it is not a little curious to find almost the same expressive simile in use, thousands of miles away, among some of the most degraded races of hopeless savages existent in the New World: we refer to the Indian forest tribes upon the Amazon River in Brazil, who speak of these waterways as their "canoe paths," † and we mention the matter as a remarkable instance of the elegance of diction so often to be found among the wildest children of Nature, who draw all their ideas and similes from the Great Book of Nature, their only study.

A forest stream regarded simply as a "canoe path" we need hardly say, supplies a natural highway, smoother, more beautiful, and more enduring than anything ever constructed by human hands—in comparison to such a pathway, the imperishable surface of "The Appian

* *History of the Conspiracy of Pontiac*, by Francis Parkman (the younger), 1885, Vol. i., p. 147.

† See *Brazil, the River Amazon, and the Coast*, by Herbert H. Smith, 1880, p. 87.

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Way," laboriously constructed by the skill of ancient Roman craftsmen, endures but for a day.

But Time leaves no trace of its destructive power upon the natural landscape, and so it comes to pass that we constantly find a wonderful resemblance in the cast of thought and mode of expression among the people of the wilderness, wherever their lot may have been cast: here we see the same idea striking the dweller beneath the shadows of the great equatorial forests, and the wanderer through the pathless wilds of the Canadian woods, which, at the time we refer to, covered almost the whole of the eastern side of North America in one continuous labyrinth of trees.

Now in the early colonial days in America the prosperity of a frontier town mainly depended, as we have already explained, upon its inland trade with the Indian tribes; and in consequence those advanced posts of which we have spoken were pushed on further and further into the unknown wilderness beyond, where it was their main objective to hold the pass to some point which lay upon the head waters of some great inland river system, upon which canoes, and bateaux, the white man's form of boat, could float down, it might be for thousands of miles, throughout the then almost wholly unexplored interior, and from whence they could sally forth as from a maritime port, and subsequently return laden with costly furs and other merchandise, obtained from the native tribes in exchange for articles of European manufacture.

Two such places were: the celebrated Fort Duquesne, built by the French in 1754, at the point of junction of the Monagahela with the Ohio, where the present city of Pittsburg now stands—the other was

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Fort Oswego, built by the British in 1726, upon the mouth of the river of that name, where it debouches into the south eastern end of Lake Ontario. The commercial and strategic importance of these posts was at once recognized by the governors of both these rival nations, and for several years a bitter war was waged between them, mainly with the object of ousting his opponent from the possession of one or other of these places. The disastrous result of an expedition sent out by the British for the reduction of the first-named, in 1755, we have already spoken of: but true to their history, notwithstanding this and other most serious, and at the time almost ruinous defeats at the hands of the French (of whom it must be said that 150 years ago, they possessed much more able leaders than the English in North America), the British still stubbornly fought on, and on, both by sea and land, until at length the tide of fortune changed; the British arms were completely successful at all points, and the French regime in Canada was brought to an end in 1760. Fort Duquesne (the Gate of the West) we need hardly add, in the general downfall of the French power in North America, had already passed, some two years before the final catastrophe, into British hands; another force fitted out against the French by their redoubtable enemy (in those days), was known to be rapidly pushing its way through the forest; their Indian scouts brought them daily notice of its approach: and the French garrison, which at that time was only some 500 strong, after blowing up the magazines, fled in bateaux down the Ohio; and the next day (Nov. 28th, 1758) the British standard waved in triumph above the ruined battlements, which

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had cost her so much treasure and her troops such losses and reverses, during a long period of arduous warfare.

Oswego, in the same way, had always been a bone of contention, and an object of envy to the French. In 1727, the year after it was first garrisoned by the British, the French governor at Quebec demanded its evacuation on the ground that it was erected on French territory. This being refused it was summoned to surrender, but the British stubbornly held their ground; after many threatenings it was however at length captured by Montcalm, Aug. 14th, 1756, but it was re-occupied by the British again, not long afterwards.

Though matters political are to a great degree foreign to the objects of this work, yet the supreme importance, in a great forest country above all other places, of firmly maintaining judiciously selected inland frontier posts giving access to extensive systems of water communications opening up the interior of the country, must be evident to all colonizing peoples; that being so therefore, we regard a digression into this subject as not altogether irrelevant to the scope of a work professing to deal with the Wilderness and its Tenants. The policy of the future is reflected in the mirror of the past: it cannot consequently be aught but profitable to take a hasty glance, ere we close this section, at the salient features of the great struggle which arose out of disputes with reference to these matters and other boundary questions, between Great Britain and France, towards the middle of the 18th century in North America.

The prize in dispute was a great one; for the North American forest belt, in this zone, was incom-

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parably the most valuable and splendid of all colonial possessions.

Resting upon the port of New York, as a basis of supply by sea, the British northern line of communications, 150 years ago, was the Hudson River to Albany;* thence it divided into two branches: the first via the Upper Hudson to Lakes George and Champlain, and thence to the St. Lawrence: the other via the Mohawk River—thence by a short portage to a narrow channel called "Woods Creek," which gave access by a series of lakes and streams for a distance of nearly 300 miles to Fort Oswego on Lake Ontario. Such in brief were their main trade-routes with the great lakes, and the whole of the mighty western wilderness.†

The possession of Oswego by the British was found to be ruinous to the French fur trade with the Indians, for the British gave the western Indians, who brought their peltries to exchange for goods, both better prices and better goods than the French, and their business was much more skilfully conducted than that of their rivals—there was far less of red tape and fewer vexatious restrictions upon trade than there were in Canada under the old regime. The British Indian trade at Oswego and Albany in consequence flourished exceedingly, and above all, by fair dealing and a judicious Indian policy, the friendship of almost the whole of the native tribes inhabiting the shores of the great

* Distance 144 miles by water.

† There were two ancient passes from Lake Erie to the Ohio River, thus giving access to the Mississippi and great internal river systems. The first of these was via Sandusky Creek to the head waters of the Sioto, which was navigable for large boats 200 miles to the Ohio; the other via the Miami River and down the Wabash to the Ohio, a distance of 412 miles. These were the ancient trade-routes marked upon the old maps.

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lakes was secured to the British: though many of these Indians had previously been attached to the French interest.

Here we must explain, that if the British had not in this way maintained these friendly communications with the red Indian tribes, the latter would most certainly all have joined the French alliances against Great Britain, not only in matters of peaceful trade, but also in war.

There cannot be a shadow of a doubt that in such case, the Indians, instigated by French agents, would have kept up a perpetual border warfare against the British. This in fact was what "the French Indians" and Canadian tribes generally did, even as it was. In this way, it was hoped that the British settlers would have eventually become tired out, and have thrown up their lands in disgust; and unquestionably if support had not constantly been sent out from England, the thing would have ended either in the British being expelled from America altogether, or at the very least they would have been ignominiously driven back to a few isolated trading posts adjacent to the Atlantic seaboard.

To effect this had been the constant and avowed policy of France up to the middle of the 18th century, at which time the whole continent of North America was practically claimed as hers.

Now it is certain that it was the possession of advanced posts such as Albany, Oswego, Fort Edward, Fort William Henry, and other frontier forts in that section of country, which enabled the British to maintain

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their important alliance with "The Six Nations," * a combination of powerful Indian tribes inhabiting the country from the head waters of the Connecticut to the Oswego; and thence to the westward of the latter river. The late Mr. Francis Parkman, the American historian of Canada, is most emphatic upon this point, and gives ample proof of the vast influence which these places exercised upon the Indian trade and politics. The line of communications by which they were supplied was, as we have said, *by water*, as they could never have been held by trails through the forest. The supreme importance therefore, from a military point of view, of maintaining the command of the principal waterways giving access to the far interior of this, and other continents, when important British interests have to be maintained, must be evident. This however, raises questions which can be more conveniently discussed in our chapter upon "The Great River Systems," we shall therefore take leave of the Forest Region of the Temperate Zone at this point.

* These were—(1) The Mohawks—(2) The Onondagas—(3) The Senecas—(4) The Oneidas—(5) The Cayugas—and (6) The Tuscaroras—known as the Iroquois Confederacy, and forming probably the only real example of ***intimate union*** recorded in the history of the American Red aborigines. All other Indian confederacies were mostly mere ropes of sand.

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CHAPTER X.

THE ARCTIC OR POLAR ZONE.

Its Position and Extent. Early Arctic Voyages. Highest Latitude yet Attained. Value of Polar Researches. The Arctic Regions as a Field for the Study of Natural History. Northern Limits of Tree Growth. The Arctic Birch. A probable Survival of a Temperate Era. Unchangeableness of Nature. Example of Egypt during 6000 Years. Probable Vast Antiquity of the Spitzbergen Birch. The Arctic Summer Thaw. The Midnight Sun. Wonderful Rapidity of Growth under Constant Sunlight. Effects of Sunshine on Ice and Snow. Winter Descent of Arctic Cold into Temperate Regions. Open Sea during Winter on the North Coast of Norway. Ice in the Baltic. Causes of these Anomalies. The Gulf Stream. Drift Wood. Tree Life near Hammerfest. Cause of the Closure of the Baltic by Ice. Freezing-point of Sea Water. Baltic Pine Forests. The Subarctic Summer's Night. Midnight Sun at the North Cape. Splendid Panorama of Arctic Solitudes. The Spitzbergen Summer. Snow Blindness. Serious Effects of Ice Glaze. Probable Combination of "Sun Burn" and "Frost Bite." Icy Winds. Uses of Goggles and Cloth Masks. The Period of Constant Day in Norway. Arctic Hay Crops. Crops of Lapland. Antiseptic State of the Atmosphere in Great Cold. Unchanged Corpses 250 Years Old. Frozen Bodies of Extinct Monsters. Arctic Plants. Effect of Snow in Protecting Vegetation. Arctic Flowers, Mosses, and Lichens. The Arctic Fauna. Wild Reindeer in Spitzbergen. Theory of their Arrival from Unknown Lands to the Northwards. Difficulties of Travel over Ice Hummocks. The Spitzbergen Islands. How Polar Animals Live. Immense Size and Fatness of the Spitzbergen Deer. Reindeer Moss. Habits of Reindeer. Caribou and Caribou Migrations. Causes of Migrations of Animals and Birds. Vast Concourse of Migratory Birds in the Arctic Zone. Uprising of a Vast Flock of Geese. Successive Arrivals of Arctic Migrants. Antarctic Geese. The Subarctic Bush Forest. Sudden Break-up of the Arctic Winter. Some of the Scientific Aspects of Snow. Its Immobility. The Permanent Storing up of Cold in Snow. Its Effects upon Climate. The Melting of the Great Snows by Heated Air. Mr. Seebohm on the Sudden Transition from Winter to Summer on the Yenesay. Extraordinary Power of the South Wind in Dissolving Snow. Immediate Arrival of Migratory Birds. Wonderful Character of these Migrations. Migratory Flights at Great Altitudes. Nocturnal Drama of the Air. Punctuality of Railway and Steamer Records beaten by Birds. Speed of Bird Flights. Mortality During Migration. Immense Length of Flights Taken. Beauty of the Arctic Summers, Linnæus

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upon. Mr. Wheelwright on Game in Lapland. Permanent Habitants of the Polar Regions. Birds. Animals. Polar Bears. Musk Oxen. Nutritive Value of Reindeer Moss. Reindeer Burrowing in the Snow for Moss. American Buffalo in Deep Snows. Scent and Weight of Musk Oxen. Fossil Musk Oxen. Probable Great Antiquity of the Genus. The Preservation of Primeval Types. Why One Survives and Another Perishes. The Arctic Hare, and Smaller Rodents. Animals Living in Snow Drifts. Plants Growing Beneath the Snow. The Purple Arctic Saxifrage. Plants in a Dormant State beneath Glaciers. Holes of Arctic Animals in Snow Drifts. Caverns, or Open Spaces beneath the Snow. How formed. Supporting Power of Snow. Snows Melting at the Ground Level. Ice Forming on the Roofs of Cavities. Why Snow, Touching the Ground, Melts. Delicate Creatures Living in Warmth and Safety beneath the Drifts. The Lemming. The Arctic Mouse. Arctic Mirage. Arctic Hares. How the Polar Hare Lives. Ptarmigan. Birds Flying into Snow Drifts. Black Cock rising out of Snow. Condition of Snow in Great Cold. Protective Colourings of Arctic Birds and Beasts. South Kensington Museum Specimens. How Nature produces Albinism. Arrest of Pigmentation in the Human Hair. Hair Follicles. Hares Turning White during Severe Winters. Similarity of Effects of Great Cold and of Great Heat. Trees Cracking in Frosts. Shrinkage of Woods, Horn, Bone, etc. Fall of the Leaf of Trees, caused by Intense Dry Heat, or by Winter Cold. Similarity of Atmospheric Electrical Conditions. The Skin Burnt by Metals in Great Cold. Similarity between Burns and Frost Bites. Treatment of Superficial Frost Bites. Severe Frost Bites. Congelation. Persons Frozen to Death generally Found partly Naked. Scientific Aspects of Cold as Regards the Human Frame. Dr. Garrod's Experiments. Tendency to Sleep. Phenomena of Death by Cold. People Frozen in Blizzards. Falling into the Sea, in the Arctic Regions. Health in the Polar Climates. The Therapeutic Effects of Dry Cold. Effects of Wind in Polar Climates, Professor Nordenskiold upon. Sir George Nares's Opinions. Precautions in Great Cold. Canadian Winters. Progressive Cold of the Arctic Night. Lowest Recorded Temperatures. Return of the Sun accompanied by the Greatest Cold. Effects of Intense Cold on Ships' Stores. Difficulties of Arctic Travel. How Salt Ice turns Fresh. Icebergs. Movements of Glaciers. Icebergs Breaking off Greenland Glaciers. Ice Cliffs near Behring's Straits. The Antarctic Ice Barrier. Storms and Intense Severity of Climate in the Antarctic Seas. Great Movements of Antarctic Ice. Mammoth Icebergs. Precautions against Ice at Sea. Sledging Parties on Polar Ice. Impracticability of Reaching the Pole in this Way. Sledging restricted to Spring and Summer. Why Impossible in Winter. Arctic and Subarctic Snows. Canadian Winter Camps. Beautiful Effects of Freshly Fallen Snow. The Aurora Borealis. Showers of Ice Crystals. Temperature of the Realms of Space. The Arctic Night. Moonlight in the Arctic Regions. Brilliancy of Stars. Electrical Phenomena. "The Boreal Crown." Spring Break-up of the Polar Ice. The Scriptures on Snow, Ice, and Cold. Attractions of the Arctic Region to Explorers. Health as Affected by

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Residence in an Arctic Climate. Winter in the Hudson's Bay Territory. Hudson's Bay Co's Officers. Their Attachment to the Service. Mr. Warburton Pike on the Charms of the North. Indian Appreciation of its Beauty. Winter at the Great Slave Lake. Concluding Remarks.

THE Arctic or Polar Zone forms the last of the great terrestrial zones into which we have ventured to divide the earth, while endeavouring to present the various aspects of Nature to the reader's notice. It extends from the Arctic Circle, which is drawn by geographers at the parallels of 66° 32′ North and South latitude, to the poles, in both hemispheres; thus embracing within its limits an immense region in each hemisphere, circular in its form, and having a radius of 1408 geographical miles, drawn from the poles.

At the south pole this zone is of course known as the Antarctic circumpolar region; for the sake of brevity however, we have simply described it under the general designation of "The Arctic Zone," for with the exception of a very small number of expeditions, sent out by the governments of Great Britain, France, and the United States (the most recent of which was despatched in 1840, by the last-named power), no attempt whatever has been made to explore the antarctic regions, which therefore remain a "terra incognita" to the present day. *

There has recently been some talk of sending out another expedition, promoted we believe, by our

* A private attempt at Antarctic exploration, in connection with the right whale fishery, was made during the summer of 1894—5, but as a commercial venture it proved a failure, no right whales being seen. (An account of this voyage, given before a meeting of the Victoria Geographical Society, appeared in the Melbourne Argus of March 20, 1895).

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Australian colonies, fitted out with all the most modern appliances which naval science can suggest, so as to penetrate as far as possible towards the Southern Pole; but, up to the time of writing these lines, the proposition has taken no definite form, and nothing of a practical nature has been done to carry out the suggestion: probably in consequence of doubts expressed by the naval authorities, as to whether any useful results would be likely to accrue, sufficient to warrant the risk and expense, which it is estimated would amount to at least £15,000 before any attempt could be made to penetrate into these stormy and inhospitable regions, where all existing knowledge seems to warrant the belief that the cold is more intense, and the climate in every way more rigorous, than it is in corresponding situations within the Northern Polar Zone: so imperfect indeed is our knowledge of even this last-named region, which has been the objective of innumerable expeditions for centuries past, that the last edition of the *Encyclopædia Britannica* has thought itself warranted in summing up the results attained by them, for so far, in the following terms:

"Our ignorance of about three millions of square miles, within the North Polar Circle, debars us from the possibility of considering the physical geography of the Polar regions as a whole." *

That being so, and our knowledge of the antarctic regions being infinitely more scanty, we venture to think we need make no further apology to our readers for calling this section of our work "The Arctic Zone" without special mention of the Southern Polar Regions.

At the same time it is not a little remarkable from

* *Encycl. Brit.*, 9th Edit., Vol. xix, p. 327.

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how early a period in the history of Navigation, we find mention made of Polar expeditions, and still more curious is it to observe how wonderfully successful some of these ancient mariners were, in penetrating to very high latitudes; especially when we consider the scanty means at their disposal, and the primitive state of shipping and naval science, in those days.

It is not our intention to weary our readers with any detailed historical account of Polar expeditions; we may mention however, that so long ago as 1235, the Scandinavian Norsemen had made settlements on the shores of Greenland, as testified by one of their Runic stones bearing that date, found in a cairn in Lat. 73° N. And among the records of early polar voyages, we find that Sebastian Cabot sailed under Sir Hugh Willoughby, May 20, 1553, "for search and discovery." In 1556 Stephen Burrough sailed to the Kara Sea. Frobisher's expedition sailed in 1576, and that of Davies in 1585. While the renowned navigators, Hudson, first sailed in 1607, and Baffin in 1615, * men whose names, as we know, are still preserved, probably to all time, in the names of "Hudson's Bay" and "Baffin's Bay," which were respectively so called to perpetuate the memories of these adventurous seamen. Since those days a great number of expeditions have sailed from time to time, in which nearly all the leading naval powers have taken a part, with a view to extend the range of human knowledge in this direction. It is however somewhat disheartening to observe how small are the results which have been obtained in comparison with the outlay, the sufferings, and the losses which have been incurred.

* *Encycl. Brit.*, 9th Edit., Vol. xix, p. 316, 317.

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Exactly who has reached the furthest point north, seems to be somewhat uncertain. The Americans assert that it was done by one of their expeditions; the claim is thus put forward by Lieutenant Greeley, U.S.N., who commanded the United States Expedition sent out in 1881, for he says in his book—"Lieutenant Lockwood, U.S.N., attained to Lat. 83° 23′ 8″, the highest latitude ever attained by man," * while in the British Expedition, under Captain Sir George Nares, R.N., that officer states in his account, that on May 12, 1876, Commander Markham, R.N., of H.M.S. *Alert*, reached Lat. 83° 20′ 26″ N. † so that there is only about three nautical miles between them in any case.

Yet so long ago as 1827, in the days of the old sailing ships, Sir Edward Parry, another British officer, got as far as Lat. 82° 45′ N. § or within about 30 nautical miles of the highest of either of the two foregoing estimates; both of which we need hardly say may vary a few miles from the true position, as single observations are never to be implicitly relied upon. So well is this known by nautical men, that whenever the exact latitude of a place has to be ascertained, it is usual to take the mean of a number of observations obtained from stars, which are found to give more accurate results than either solars or lunars. That being so, we consider that we are justified in saying, that it would be unsafe to assume that the Americans

* *Three Years' Arctic Service*, by A. W. Greeley, Lieut. U.S.N., Vol. i, p. 335.

† *Arctic Voyage*, by Capt. Sir Geo. Nares, R.N., 1878, Vol. i, p. 377. (These points have however been very much overpassed by Herr Nansen, a Norwegian, who has just returned (August, 1896) from the Polar regions and claims to have reached Lat. 86° 14′ N. This intelligence reached Europe while these pages were in the press).

§ *Ibid.*, p. 173.

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got three miles nearer to the pole than the British, and that it does not seem to be quite established which of these expeditions did so, if the point is deemed worthy of debate.

As regards the still older voyages, it is, as we have said, not a little remarkable, how nearly they came up to the very best results obtained by the aid of steam, aided by all the means and appliances within reach of modern navigators. These fine old sailors, many of them, as we know, set sail towards the frozen north in quest of what is now ascertained to be a fallacy; namely, to discover a short route to the Indies, via the North West passage. This North West passage it is true, was effected by Captain M'Clure in 1850—but the only useful result which followed that discovery was to satisfy the world, that as a trade route it was as impracticable as if it did not exist at all. Still it is not the less wonderful to think that so long ago as 1607, Hudson, in the clumsy galleons of nearly three centuries back, made his way in pursuit of this idea, to Lat. 80° 23′ N., a point only about 180 miles short of the furthest point reached up to the present time.

This must be regarded as a remarkable achievement, considering the state of nautical science at that period.

Turning however, from what we must call these somewhat disheartening results of modern efforts at Polar exploration, let us endeavour to picture in our mind's eye, what sort of country it is, for the discovery and examination of which so many costly expeditions have been fitted out, and so many valuable lives sacrificed. Have the results that have been obtained been worth all this expenditure of life and capital?

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Opinions as to this, of course, may differ, but for ourselves we have no hesitation in asserting, that every endeavour to spread the light of knowledge over the dark corners of the earth, in the end is worth the cost—and in these pages, we trust, we shall be able to show that a great deal of very interesting and also very valuable information, has been obtained respecting the arctic regions by recent explorations. These modern expeditions have been mainly or altogether undertaken for scientific purposes, whereas the objects of the early explorers were essentially different; for they were generally prompted by a thirst for gold, or the discovery of mythical lands, supposed to contain enormous wealth, which rumour asserted to exist beyond the western seas.

Others again set forth in search of more substantial gains, in the way of whale oil, or seal and walrus skins, and so forth; but it has been reserved for our modern navigators to brave the dangers of the icy seas in the pure spirit of scientific observation and study. That results worthy of these efforts may reasonably be expected to accrue from future expeditions, is the view still held by the majority of scientific men.

Many questions of high scientific importance yet remain to be solved by means of Polar research; of this there can be but little doubt. The late learned geographer and meteorologist, Lieutenant Maury, of the United States Navy (whose writings upon Navigation, and upon the Physical Geography of the Sea, are still regarded as standard works), for instance, was always strongly impressed with this opinion, and in eloquent terms set forth, for our instruction, the vast importance which in his opinion these desolate regions exercise upon the

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general economy of terrestrial Nature, and upon the well-being of man throughout the world; there, he says—

"the icebergs are framed and glaciers launched; there the tides have their cradle, the whales their nursery; there the winds complete their circuit; and the currents of the sea their round in the wonderful system of oceanic circulation; there the Aurora is lighted up, and the trembling needle brought to rest; and there too, in the mazes of that mystic circle, terrestrial forces of occult powers, and of vast influence upon the well-being of man, are continually at work. It is a circle of the mysteries; and the desire to enter it, to explore its untrodden wastes and secret chambers, and to study its physical aspects, has grown into a longing. Noble daring has made arctic ice, and snow-clad seas, classic ground."*

In addition to all these things, important questions respecting the magnetic pole, the mariner's compass, and other nautical matters, may be included in the list of objects for which arctic exploration is expected to furnish valuable results. In Natural History too, a vast field of observation is sure to be opened up—these barren grounds being the breeding places of countless myriads of birds, which from the furthest regions of the earth resort there during their annual migrations. To the naturalist therefore, a visit to these regions must be regarded as of supreme importance, as affording opportunities which could not possibly be obtained elsewhere, for observing the habits of birds, many of them of rare varieties, which here congregate during the summer months. Many birds, there can be no doubt, penetrate vast distances to the northward—wherever in fact patches of open water can

* *The Physical Geography of the Sea*, by Lieut. Maury, U.S.N., 16th Edit., 1877, p. 207.

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be found—and some, it may be, even to the pole itself, while others seem to be confined to the bushy belt of dwarf forest which frequently is found to extend into the southern borders of this zone.—This is a subject upon which the annals of the polar regions teem with interest, though we fear it will be impossible to do justice to it in the short space we shall be able to devote to it here.

As a rule the Arctic Zone, except towards its southern limits, is of course generally destitute of anything like a regular forest growth. The extreme severity of the climate, the great length of the winters, and the constant existence of frost in the deeper subsoil, is of itself sufficient to forbid the possibility of any luxuriant tree growth; nevertheless trees of several kinds, of stunted growth, from our last division, "The Great Forest Region of the Temperate Zone," do extend, in many places, to a certain distance into this zone, though we fear the materials for tracing the exact limits of arboreal vegetation at this point are not forthcoming; we are therefore unable to state exactly the furthest northern limits of the forest, except at a few very well-known points. In Norway, for instance, where on account of the supposed set of the Gulf Stream, along its western coasts, we might have expected timber to have reached a very high latitude—Professor Nordenskiold states that "the Northern limit (of the forest) is near Tromsöe." * (Lat. 69° 39′ 12″ N.). A growth of dwarf shrubs and bushes however extends in places nearly to the shores of the polar sea—thus, "In the neighbourhood of the North Cape, at a little distance inland,

* *Voyage of the Vega*, by Professor A. E. Nordenskiold, Vol. i, p. 42. Translated by Alexander Leslie, 1881.

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birches 3 to 4 metres high are met with." This birch is the sweet scented variety, *Betula odorata* (Bekst.); * on the other hand, contrary perhaps to what we might have expected, in Siberia trees attain a considerably higher latitude, for according to the same authority—

"they run to the beginning of the estuary delta, *i.e.*, to about 72° N. As the latitude of the North Cape is 71° 2′ 40″, the wood in Siberia goes considerably further north than in Europe. The outermost trees there, are gnarled half withered larches (*Laxix Dahurica*), and *Picea obovata*, and further east, in Kamschatka, birch." †

In Arctic America, considerably to the northward of the Great Slave Lake, according to Mr. Warburton Pike there is some well-grown pine timber § and in many places the lakes are fringed with dwarf willows and other trees. On the coasts of Alaska too, timber is found at considerable distances to the northward of the arctic circle—and the same in Labrador, on the Atlantic side. As regards the antarctic regions, we have been unable to discover any mention of trees seen growing on any of the lands which have been visited by the few explorers who have thus far visited those peculiarly desolate and stormy shores.

In the high latitudes of the northern circumpolar area however, it seems that even in Spitzbergen, situated between the 76th and 81st parallels of latitude, a few very dwarf specimens of tree life are still to be

* *Voyage of the Vega*, by Prof. A. E. Nordenskiold, Vol. i, p. 42. (N.B.—This remarkable prevalence of sweet scented vegetation in the extremes of heat and cold is a fact deserving of note).

† *Ibid.*, Vol. i, p. 43.

§ *The Barren Grounds of Northern Canada*, by Warburton Pike, 1892, p. 123.

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found in sheltered spots; these extraordinary little trees, if we may so call them, are birches of the variety "*Betula Nana*" (Var. *Relicta*) with stems which are hardly thicker than a quill, or higher than a man's knee: yet these truly Lilliputian representatives of the forest monarchs are some of them of very great age; having contrived to maintain existence through long periods of time, in spite of the death-like slumber which the icy breath of a Polar winter imposes upon them for at least nine to ten months out of every year. These stunted descendants of a fine, hardy, free-growing class of timber however, furnish us with a wonderful example of the extraordinary vitality which certain forms of vegetable life possess, under what appears to be almost every species of adverse circumstance—and competent judges generally suppose them to be a survival from the era when Spitzbergen possessed a warmer climate than she has done during historic time.

If this be, as it probably is, the fact, it is worth while to pause for a moment to consider what such a circumstance implies.

The records of the human race are now known to go back in the case of some of the oriental dynasties, for a greater number of thousands of years than is generally supposed. The present existing history of Egypt for instance, carries us back for a period of at least 6000 years. The high artistic perfections of its people show that it was an ancient empire then, but during that period we have what constitutes almost irrefragible evidence that the climate of Egypt, and therefore presumably those of the rest of the earth also, have not undergone any very great or material change.

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Had this been otherwise, it is hardly possible to doubt but that the climate there would have partaken more or less in the change—yet the oldest relics of its ancient past show conclusively that the same dry sand, the same grains, plants, fruits, flowers, and animals, existed in Egypt then, much as they do now; thus proving by the most irrefragible of all evidence, that the condition of Egypt in those days as to its climate, was not so very different, if it differed at all, from the Egypt of to-day.

That being so, it follows that arctic ice and snow covered the face of Nature in the neighbourhood of the poles from before the dawn of historic time, much in the same manner as it does at present. Had the polar axis of the earth shifted to any very appreciable extent, it must have entailed a general redistribution of climate throughout the world. The object of this digression therefore, is to show the enormous period of time during which our little friend, the birch tree of the arctic regions, must have braved the rigour of the elements upon the desolate plains of Spitzbergen. For we must bear in mind, that great as the space of historic time may appear to us to be when compared with our own brief and ephemeral period of existence—even the earliest dawn of human history is as nothing when compared with the immeasurable eternity of the past, so far as it is gauged by the space of geological time. If therefore we were enabled to put a date to the period when Spitzbergen enjoyed a milder climate than it does at present, it might carry us back to an epoch, compared with which 6000 years (the present approximate limit to which human records extend) might seem small in comparison.

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In tropical regions as we have already ventured to point out, the exuberance of life, and of vegetative power, seems to overflow the landmarks set up by human skill and labour, much as the rising tide sweeps in upon and covers the beach, left dry below high water mark *: here, in the Arctic Zone however, we have reached a region where these operations of Nature are distinguished by a quiescence closely resembling that of an eternal sleep; so slowly do they work. Thus specimens of the arctic birch, found by Nordenskiold the Swedish explorer, in Spitzbergen, "did not exceed two feet" in height, "the thickest stem being 2 to 3 lines in diameter" (that is, equal to about one quarter of an inch in thickness). Yet after the return of the expedition to Sweden, when examined by the help of a microscope, "a stem this thickness was found to be about 60 years old." † Contrast this vegetative torpor with the shooting up of giant bamboos to a height of 120 feet, in 3 or 4 months, during the tropical rains. Yet when we come to consider the matter, this exceeding slowness of growth in arctic climates ought not to appear to be so very remarkable, seeing that frost prevails there throughout almost the entire year, during which vegetation is for the most part at a standstill.

But the marvellous vegetative power of the tropical sun is thereby exhibited in its most striking aspect. Some experiments have from time to time been made, with a view to ascertain how far the thaw penetrated into the soil during the brief duration of an arctic summer, which tend to show that—

* See our chapter on "The Equatorial Zone."

† Professor A. E. Nordenskiold's *Arctic Voyage*, 1881, p. 186.

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"the depth to which in Northern countries the summer thaw penetrates, varies with the nature of the soil, but except in purely sandy, and very porous beds, it nowhere extends two feet deep in American and Siberian lands, lying within the Arctic Circle." *

So far north as Spitzbergen, this would probably be reduced to quite one-half, for at the end of July or early in August, 1881, at Jockmock in Swedish Lapland, only a very short distance within this circle, we found the frost still prevailing in great intensity, rather under than over this distance beneath the surface; and were informed by residents, that it never disappeared from the soil at that depth. The subsoil of arctic lands therefore remains in a permanently frozen state, and if it was not for the perpetual presence of the sun above the horizon in these regions, for a period of some eleven weeks during the summer season, it is probable that almost every kind of vegetation would slowly perish; but the prevalence of endless day, during this period, has the effect of so stimulating the growth of plants, that it proceeds by both night and day throughout the whole of this time with extraordinary rapidity—and this to a certain extent makes up for the exceeding shortness of the season. But the moment the nights begin again, the descent of the solar disc beneath the horizon, even for an hour or two, is instantly followed by a rapid fall in the temperature; and a short but intense interval of cold sets in, which is but tardily removed by the reappearance of the great luminary of the day, whose early rays, in these far northern regions, have but scant power

* *Zoology of the Voyage of H.M.S. Herald*, by Sir John Richardson, Edited by Professor E. Forbes, F.R.S., 1854, p. 1.

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to warm the chilled atmosphere, once they have been withdrawn from it for ever so short a time. For the greater part of the day however, during the height of the summer season, the power of the northern sun is often felt to be of very considerable intensity, so that it sometimes burns the face and hands with almost tropical power. Very hot days are therefore a thing by no means unknown, even far within the arctic circle—provided there is no wind and that the sky is clear,—during the height of its short summer: but all strong winds are of course very keen and bitter, their temperature being always low in consequence of the wide expanse of ice and snow over which they generally blow. In connection with this fact it is well to bear in mind, that though snow-clad ground and clear ice have the faculty of reflecting heat, very strongly, they do so without absorbing heat. Hence it comes that on snow-clad mountains, for instance, while the sun shines brightly, the heat is often most trying, because of the way in which the sun's rays are refracted by the snow, but the moment the genial rays of this the great source of terrestrial life are withdrawn, the cold becomes as severe as the heat appeared to be just before; the moment of sunset each evening is also immediately followed in these localities by an intense and bitter cold that seems to pierce the very marrow of one's bones. So again, during the winters at highly elevated stations, like St. Moritz in the Engadine Valley, Switzerland, situated 6089 feet over sea level; the temperatures are frequently quite of an arctic character; the night temperatures often descending to 30, and even 40 degrees below zero: yet here, during the day (when some hours of bright sunshine

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are usually enjoyed in fine weather), though the thermometer may still stand many degrees below zero (Fahr.) in the shade, persons skating on the lakes are perhaps obliged to wear the thinnest dress materials, on account of the great amount of heat refracted from the surface of the ice and snow. So long as the sun remains brightly shining therefore, they enjoy an artificial summer; but the moment it goes down behind the mountains, furs must be put on at once by persons remaining in the open air; otherwise exposure to the intense cold would speedily produce frost bite, or other serious results.

Hence it appears that persons who ascend to great elevations upon mountains enter what is practically an artificial arctic region, closely resembling in many of its aspects the normal conditions of a Polar land. There the day represents the arctic summer; while the night closes in with all the severity of winter within the arctic circle; and instances, as we know, are not uncommon, where travellers, benighted upon high mountains without shelter, have perished of cold, almost more frequently than such accidents have occurred during Polar expeditions.

It is remarkable too, the great distances to which during the depth of winter, the climate of the arctic zone descends into temperate regions, and for considerable periods of time continues to keep the temperature down almost or quite as low as it falls in the highest known latitudes.

These exceedingly low temperatures have been frequently noted in the Hudson's Bay Territories, in Siberia, etc., but we shall refer to the matter again when considering the question of the arctic cold.

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On the other hand, it is no less remarkable how the isothermal contours are deflected towards the north, at certain points, as if they were the gates of Nature, placed there by her own beneficent hand to give entrance to those icy realms, where the empire of frost under normal conditions holds perpetual sway.

Professor Meyen, for this reason, in his division of the earth into Climatic Zones, has subdivided the great region thus periodically invaded by the arctic winter, into no less than four distinct areas, which he has named "The Colder Temperate Zone" (45° to 58° Lat. N. and S.), "The Subarctic Zone" (Lat. 58° to the Arctic and Antarctic Circles—66° 32′ N. and S.), "The Arctic Zone" (from Lat. 66° 32′ N. and S. to Lat. 72°), and "The Polar Zone" (all tracts of land beyond Lat. 72° N. and S.); * his object being to define, as accurately as possible, the geographical limits of the plants etc., contained therein.

We have however, contented ourselves with a much simpler division, embracing the last two of Professor Meyen's in what we have called "The Arctic Zone," but always subject to the reservation, which we have not failed constantly to insist upon in tracing the limits of all our terrestrial zones, that nowhere are there any hard and fast lines, at which we can set bounds to the climatic changes of Nature, or say "Thus far, but no further;" on the contrary, experience shows that local circumstances often involve far-reaching exceptions and changes, which it is our duty to recognise and point out, endeavouring at the same time, to trace the effects to their moving causes—

* *Outlines of the Geography of Plants*, by Franz J. F. Meyen, M.D., Professor of Botany at the University of Berlin, 1846, pp. 161—220.

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whether it be to elevation of the land above the sea, or to the winds, or the great oceanic currents, and the various proportions of moisture in the atmosphere.

All these things, as we have repeatedly had occasion to show, may so far modify the climates of the earth, at particular points, that one might be tempted to exclaim—"Climatic Zones do not exist at all!—the idea is a delusion and a snare!"

But when we come to carefully examine into the probable causes which produce these changes, in many cases we can (as we humbly conceive) point out the plain reason why they come about; which we generally find set forth, for our guidance and instruction, in the Great Book of Nature, in characters so clear that he who runs may read.

We find a good instance in point within the arctic zone at Hammerfest, a town of some 2000 inhabitants, situated on the northern coast of Norway, in Lat. 70° 40′ N., Long. 23° 42′ E. It was founded in 1787, and had then, and still has, the distinction of being the most northern town in the world: situated not so very far south of the boundary of Professor Meyen's "Polar Zone."

Sir John Franklin with his ships the *Erebus* and *Terror*, was beset by ice, at the beginning of the winter of 1846, upon almost the same parallel of latitude: namely in Lat. 70° 50′ N., Long. 98° 23′ W.; and as we know, not one of the 138 persons who composed the personnel of that expedition, ever returned to tell the tale. Altogether 23 expeditions were sent out in search of them, by land and by sea; but it was not till long after—namely on May 6th 1859—that a paper was discovered by Lieute-

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nant Hobson in a cairn, certifying to the above facts and stating that Franklin, their gallant leader, had succumbed on April 22, 1848. Captain Sir F. L. M'Clintock, R.N., returning in the *Fox* from the search, during the autumn of 1859, was thus at last enabled to bring home certain information of the disaster, in the shape of relics belonging to Franklin and other members of this company, some of whose bleaching skeletons they had discovered and buried.

Yet at Hammerfest, in nearly the same latitude as where these losses occurred, we find that the ocean very rarely freezes at all—and then only for short periods with thin ice; so that Hammerfest, though so far within the arctic circle, may be considered a port that is open throughout the year, while far to the south of it, in the Baltic, the iron grip of winter closes every harbour: frost seals up the seas there every winter, and transforms them into solid fields of heavy ice, over which armies can march, and traffic can be carried on as upon a public road. Now why should these things be—or how shall we account for them? In this case we are able at once to assign two reasons which furnish a complete explanation of this apparent anomaly.

In the first place, the set of that marvellous regulator of climates, the Gulf Stream, impinges strongly upon the North Western extremity of Europe at the point where Hammerfest is located, so that we are here met with the remarkable fact of an ocean current governing the actions of men upon the dry land; and actually choosing the site of a town for them. It is the warm water, brought up from tropical latitudes

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across an expanse of stormy ocean, thousands of miles in width, that causes the port of Hammerfest to be kept clear of ice throughout the year.

That this is so, there is not a shadow of a doubt, for upon its waves the current carries with it irrefragible testimony of its origin, in the quantity of drift-wood that it is constantly depositing all along these coasts, which affords an unfailing supply of firewood to their inhabitants. Experts have also frequently examined the timber thus cast up, and have found that a good deal of it consists of sorts growing only in tropical lands, and known to flourish in Central America and the West Indian Islands, from whence the Gulf Stream proceeds: — "The large seeds of the 'Entada Gigalobium'" for instance, "carried by the Gulf Stream from the Gulf of Mexico, are found at the northern extremity of Spitzbergen," * and so greatly does its tepid water modify the climate, in these high latitudes, that whereas, as we have stated on the authority of Professor Nordenskiold, the regular forest stops at Tromsöe (Lat. 69° 39′ 12″ N.), which he assigns as the northern limit of trees upon the west coast, we are assured on what seems competent authority, that they reappeared again, and used to flourish in former days, upon the island of Kvalo (*i.e.* Whale Island), upon which the town of Hammerfest stands, which "was once well wooded, but there are now no trees left, except a small birch wood, 6 kilometres in the south part of the island," † the other trees having all been cut down for firewood.

* *Encycl. Brit.*, 9th Edition, Vol. xxii, p. 408.

† Murray's *Handbook for Travellers in Norway*, 8th Edition, 1892, p. 179.

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Next, as regards the annual sealing up of the Baltic by ice, throughout the winter months, a glance at the map will show how the narrow entrance to it from the ocean deprives it to a very great extent from participation in the benefits which the Gulf Stream confers upon the western coasts of Europe. The salt water from the open sea enters slowly here, the set of the current in the straits being twofold, *i.e.*, an under current of salt water runs *in*, and an upper current of brackish water runs *out*. * The reader on consulting the map will also observe the great number and size of the rivers which descend into the gulfs of Bothnia and Finland.

These rivers are fed during the summer season by vast volumes of water proceeding from the melting snows, and the volume of their discharge into the sea is therefore out of all proportion greater than the length of their courses would seem to imply. The consequence is the greater part of the Baltic is fresh water, and though the fact may not be generally known is not in the strict sense of the word "a sea" at all. The salt water goes up very little further than the latitude of Stockholm. † The Gulf of Bothnia and the Gulf of Finland are both of them almost entirely fresh water. Perch and pike are angled for and taken right out at sea in the Gulf of Bothnia, so are trout and other fresh water fish. §

Now, as we all know, the freezing point of *fresh* water is 32° Fahr., whereas "28° Fahr. is the tem-

* *Maury's Sailing Directions*, also his *Physical Geography of the Sea*, Edition of 1869, p. 156.

† Stated on authority of captains of Swedish steamers plying alon the Baltic ports.

§ Same authorities.

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perature average *sea* water invariably assumes during the process of congelation;" and it appears that during a series of experiments undertaken with a view of determining the temperature of the water in the arctic regions "De Haven invariably found the temperature of the sea water, immediately under the ice, to be 28° Fahr." * Here therefore, we have an additional reason, which of itself would go far to explain why "the Baltic" (a general name for these land-locked seas) should freeze up in winter. Because not only does it do so at a higher temperature than the ocean, but also the climate on the Swedish side is distinctly colder, and more rigorous in winter than it is upon the Norwegian coasts, and the temperature often descends there *below* what is usual even at Hammerfest. Visitors to the Baltic will however be charmed with the beauty of its wooded shores, which are almost everywhere covered to the tops of the highest hills with luxuriant pine forest, which continues to cover the uncleared interior of the country up to and beyond the arctic circle, where the fir trees in sheltered ravines and on alluvial lands still flourish with considerable freedom of growth. Very fine timber in fact grows there, as we have ourselves seen.

The cause of this luxuriant growth of trees upon the Gulf of Bothnia notwithstanding the severity of its climate, is of course the greater length and warmth of its summer season, and the protecting range of mountains to the westward, which break the force of

* *The Physical Geography of the Sea*, by Lieut. Maury, U.S.N., 16th Edition, p. 282.

N.B.—The officer referred to is Lieut. De Haven, U.S.N., who was in command of one of the expeditions sent out by the U.S. in search of Sir John Franklin.

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the Atlantic gales, whose biting blasts in northern latitudes, as we know, injuriously affect the growth of trees, even much more to the southwards. On the west coast of Ireland, for instance, trees planted in spots exposed to the full force of the sea breezes may often be seen sheared off at the tops, as if dressed by the pruning knife.

On the west coast of Norway therefore, in like manner, a sterile belt of rocky islands and headlands generally occupies the coast line, whose stern and rugged grandeur impart a beauty all their own to these wild and storm-beaten shores; it is only by degrees, as a certain amount of shelter is obtained, that the pine forest begins, and even then it is confined to ravines and valleys, the higher portions of the hills always assuming a more or less arctic aspect.

It is at a little to the southward of Bodö that the midnight sun first begins actually to be seen; not that this, however, very materially affects the aspects of the midsummer's night, even considerably further to the south, for perpetual day may then be said to reign over pretty well the whole of the Scandinavian Peninsula; at Trondjem for instance an ordinary newspaper can be read without difficulty in the open air at midnight, during the month of June, and part of July, the upper edge of the sun being only just below the northern horizon, where its afterglow still lingers, till its rising again, in brilliant tints of red and orange. Very beautiful effects are thus often to be seen at this season, and if we might be pardoned for "making a bull," we should say that the busiest part of the day in these Norwegian ports is often at midnight, when everybody seems to be at his work, and generally to

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prefer those cool hours, to midday, when the sun is often oppressively hot, and shines with intense brilliancy and power. A very great and wearisome nuisance this prevalence of continual day soon proves to most travellers, who find it difficult to sleep on account of the light. The darkness of the night therefore, may be regarded as one of those blessings to mankind, whose value can only be properly appreciated by the dwellers in high latitudes, or by the inhabitants of tropical lands, where the night comes to give a blessed relief from the exhausting heat and glare of day.

At Hammerfest the midnight sun is of course seen in all its glory; there is a mountain called "Tyren" near the town, 1230 feet in height, which tourists are in the habit of ascending to witness the unwonted spectacle from its summit, where it is said that the sun is visible at midnight from May 13th to July 29th.* Another favorite point of view is from the North Cape in Lat. 71° 11′ 40″ N., Long. 25° 44′ 0″ E. This lofty headland, situated on Magero Island, which is slightly detached from the mainland, is generally accounted the most northern point of the continent of Europe. Here a grand cliff rises from the sea, in some places quite perpendicularly, to a height of about 968 feet, and the view from the edge of the precipice extends over the ocean to the north, far away towards the arctic solitudes; while at the same time the traveller enjoys a splendid panorama of what is probably one of the wildest and finest pieces of coast scenery in the world. "The midnight sun is finely seen here. The altitude of its centre, at midnight, on June 21 is about 4

* Murray's *Handbook for Travellers in Norway*, 8th Edition, 1892, p. 180.

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degrees, but by July 26 it has sunk to 4 minutes." *

A graphic description of the phenomenon, as seen from this point, is given by Mr. Bayard Taylor in his "Northern Travel," wherein he describes with much force and beauty of style, the wonderful splendour of sky, and the impressive grandeur of the scene.

From the North Cape to Spitzbergen is only a distance of some 400 miles, in a N.N.W. direction; this group of rocky, snow-clad islands, situated between Lat. 76° 30′ and 80° 30′ north, and between the 10th and 30th parallels of east longitude, forms a sort of half way station between Greenland and Nova Zembla. Viewed from these high latitudes, according to Captain Scoresby (a whaling captain, who is still recognised as a leading authority upon matters connected with the arctic regions):

"There is nothing very remarkable in the appearance of the sun at midnight, except that when its altitude is very small, it may be viewed with the naked eye, without any painful sensation; but when it is more than 4 or 5 degrees above the horizon, it generally appears as refulgent as with the same elevation in Britain." †

Here therefore the reader will observe perfect daylight prevails throughout the whole night; little or no difference being therefore observable between midnight and any other part of the 24 hours. Speaking on this subject, Mr. John Laing, surgeon of Captain Scoresby's ship, the *Resolute* says:

"During my stay in this country (Spitzbergen) in 1806 and 1807, distinction between night and day was almost com-

* Murray's *Handbook for Travellers in Norway*, 8th edition, 1892, p. 183.

† *The Arctic Regions, their Situation, Appearance, Climate and Zoology*, by Capt. Wm. Scoresby (the younger), 1849, p. 115.

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pletely lost; any perceptible difference between the splendour and radiance of the midday and midnight sun in clear weather arose only from a different degree of altitude, and some of our most experienced Greenland sailors, when called upon deck, have frequently asked me whether it was day or night." *

In Spitzbergen, and these far northern latitudes however, as we have already had occasion to remark, the power of the rays of the noon-day sun is often remarkable, for Captain Scoresby, a keen and accurate observer proceeds to point out that—

"where they fall upon the snow-clad surface of the ice or land, they are in a great measure reflected, without producing any elevation of temperature; but where they impinge on the black exterior of a ship, the pitch on one side occasionally becomes fluid, while ice is generated on the other. A thermometer placed on the black paint, on which the sun shines, indicates a temperature of 80° or 90°, or even more, while on the opposite side, a cold of 20° is sometimes found to prevail." "This remarkable force of the sun's rays is accompanied by a corresponding intensity of light. A person placed in the centre of a field, or other compact body of ice, under a cloudless atmosphere and elevated sun, experiences such an extraordinary intensity of light, that if it be encountered for any length of time, it is not only productive of a most painful sensation in the eyes, but sometimes of temporary and even, I have heard, of permanent blindness." †

These and similar facts respecting the power of the sun's rays during the polar summer, are so well established by the unanimous testimony of those who have visited these regions, that we deem it unnecessary to

* *A Voyage to Spitzbergen*, by John Laing, Surgeon, 2nd Edition, 1818, p. 59.

† *The Arctic Regions, their Appearance, Climate, Zoology*, etc. by Capt. Wm. Scoresby, 1849, p. 115.

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quote further evidence on the subject. The affection of the eyes known as "snow-blindness" is however most common in spring; for as the sun begins to acquire power and gets bright, it thaws the upper crust of the snow fields, while the frosts which follow by night convert it into a glassy surface, covered with a film of ice of such dazzling brightness that it quickly produces a species of acute inflammation of the eyes of a very serious nature, one of the peculiar effects of which is to render the sufferer peculiarly liable to a return of it, when subsequently exposed to the same influences. Indeed the intolerable glare from this highly glazed surface is often so strongly refracted as to scorch the face and hands and all exposed surfaces as if burned by fire, sometimes producing swelling and blisters of a very extensive character. These affections are well known to every plainsman and trapper upon the American prairies, many of whom suffer severely from them, perhaps even more so than in the very far North itself.

Colonel Dodge, an officer of very great experience, whose opinions we have frequently had occasion to refer to, in his "Hunting Grounds of the Great West" states in allusion to this subject that—

"the most ordinary antidote is to smear the face around the eyes with grease and gunpowder, but this as well as goggles, green veils, and broad-brimmed hats, are all at fault. Many persons suffer very acutely, and exposed parts blister as if burned by fire. I have known cases of serious illness, the face swollen, and extremely sensitive to the touch, the eyes entirely closed, the nose a blister, the lips parched and cracked. Many persons lose the entire skin of the face, after such an exposure, and suffer for weeks." *

* *The Hunting Grounds of The Great West*, by Col. Richard J. Dodge, U.S.A., 1877, pp. 66, 67.

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These extreme cases, we need hardly say, are generally the result of imprudence, and are caused by the refraction of the sun's rays, probably accompanied by an icy wind. Alpine travellers, and others ascending high mountains, are often great sufferers from similar causes, the climate at these great altitudes, as we have already had occasion to remark, closely resembling that of the arctic regions. *

We are inclined to think that the very severe nature of the blisters in some of these cases indicates a combination of sunburn and frost-bite. It must be remembered that intensely bright suns and snow-glaze have nothing to say to the actual temperature of the atmosphere. Some of these extraordinarily bright days are frequently of remarkably low temperature, and the air may all the while be 30 or 40 degrees below zero, if there is no wind, and this in regions considerably to the south of the arctic circle. The descent of the great cold of the Polar regions into temperate lands in the centre of great continents is a well known phenomenon which occurs periodically in both hemispheres, but especially in the northern, where the area of the great plains is so enormous; and when these very low temperatures are accompanied by an icy gale, as we have pointed out in our remarks on "Blizzards" and "Northers," they become inflictions of a most serious and dangerous character, a very small degree of wind with a very low temperature being often sufficient to render travelling impossible, and even a very short exposure dangerous. Travellers in the arctic regions and other sections of country liable to these invasions,

* *Mountaineering*, by C. T. Dent, 1892, pp. 81, 82. (Badminton Library).

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should therefore always be prepared for their possible occurrence.

Coloured glass goggles, with carefully fitted and enclosed sides, are indispensable in all northern countries to avoid the risk of snow-blindness; and cloth masks, veils, gloves, etc., may have to be worn to protect the hands and face when there is a wind. These, however, are matters which deserve careful consideration: for "wind" such as we here refer to must not be supposed to be a breeze such as we are accustomed to in England, but a mere draw of air, which is quite sufficient to cause frost-bites and other serious results in very low temperatures. On the other hand great care must be taken not to overload the person with clothing so as to create perspiration, as in such case the damp clothes are apt to freeze. For this reason furs should not be worn by people while in hard exercise.

The length of the constant day during an arctic summer of course varies with the latitude, every degree further north causing an increase in it of several days' duration; but materials, we fear, are not at hand to enable us to state with precision its exact duration in the very high latitudes attained by arctic explorers, because as they are constantly on the move, no continuous observations are ever obtained at any one point. M. Du Chaillu, in his "Land of the Midnight Sun" has, however, given a table (prepared from official sources) of the gradual progress of the sun along some of the well-known fixed points upon the Norwegian coast, which we append, as it serves to convey a better idea of this phenomenon than anything else, and we have, to make it more complete, added the latitudes of the places to the table.

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	Midnight sun first seen.			*Midnight sun last seen.*		
	Upper Rim.	Half Sun.	Whole Sun.	Whole Sun.	Half Sun.	Upper Rim.
At Karasjok Lat. 68° 40′ 0″ N.	May 19	May 21	May 22	July 21	July 22	July 23
At Tromsö Lat. 69° 39′ 12″ N.	„ 18	„ 19	„ 20	„ 22	„ 24	„ 25
At Vardö Lat. 70° 21′ 36″ N.	„ 15	„ 16	„ 17	„ 26	„ 27	„ 28
At Hammerfest Lat. 70° 39′ 15″ N.	„ 13	„ 15	„ 16	„ 27	„ 28	„ 29
At North Cape Lat. 71° 11′ 40″ N.	„ 11	„ 12	„ 13	„ 30	„ 31	* Aug. 1

The reader will thus see the gradual and clock-like motion of the solar orb, in its progress to and from its highest northern declination, and we need hardly say that for considerable periods before and after the appearance of the midnight sun, the days gradually lengthen and shorten, according to the latitude, as they do elsewhere. While it remains visible above the horizon, we may add, the midnight sun is always to the north of the observer, and appears to travel in a circle round the heavens, requiring 24 hours for its completion. Of course at noon it reaches its maximum elevation in the meridian, and at midnight passes within a few degrees of altitude above the northern horizon. This considerable period of constant sunshine in the frigid zone is a beautiful and beneficent provision of Nature, whereby vast areas of fertile land near, and even within the arctic circle,

* From M. Paul Du Chaillu's *Land of the Midnight Sun*, 1881, Vol. i., p. 117. (A similar table, somewhat differently arranged, will be found in Murray's *Handbook for Norway*, 1892, p. 181).

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are rendered susceptible of cultivation. Thanks to the midnight sun, very fair crops of hay, and several sorts of grain can be raised within certain areas very far to the northward, where the frost never quits the deeper subsoil; nevertheless the genial influence of the sun's life-giving rays permeates far enough into the frozen surface to render a rude agriculture and an actually somewhat luxuriant vegetation still possible. Speaking of the country between the head of the Gulf of Bothnia, and the White Sea, M. Du Chaillu, who has himself crossed its entire extent, thus describes it:

"The country which extends from the Gulf of Bothnia to the northern extremity of Europe is almost entirely within the arctic circle. Vast areas are covered with forests of pine and fir, the latter predominating, while many hills are clad with the white birch to their very top. On the banks of some of the rivers are numerous farms and hamlets, often surrounded by fine meadows, and fields of rye, oats and barley. Vegetation is wonderfully rapid under the influence of almost constant sunshine, 7 or 8 weeks only (according to M. Du Chaillu) intervening between the sowing and the harvest." *

These remarks of M. Du Chaillu afford valuable evidence of the fertility which may exist in certain districts within the arctic zone, and upon which books have sometimes cast a doubt.

The average length of time required for the raising of similar crops in our own country is of course very much greater, and may be set down at more than double that required during ordinary years for an

* *The Land of the Midnight Sun*, by Paul Du Chaillu, 1881, Vol. i, p. 53. (We think, however, that the time is here slightly understated, as we should feel inclined to extend the interval between sowing and harvest by another two or possibly three weeks).

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arctic crop, but if so, its quality and the percentage of its yield will compensate for that.

Arctic hay, so far as we have seen it, is generally short in its length, and would make a poor show in an English market. The fields are also generally very full of beautiful wild flowers, we cannot call them weeds, but we fear they do not improve the quality of the grass as a feeding stuff. The hay harvest in Norway, Sweden and Russia forms quite a curious spectacle to the stranger, on account of the peculiar way they work it, by drying the grass on high wooden hurdles, where being exposed to the full influence of sun and wind it quickly dries, when it is at once conveyed into log huts standing in the middle of the fields, which are constructed specially for its reception.

In the high latitudes, such as that of Spitzbergen and other lands lying far to the northward, mere words can give but a faint idea of their utter desolation and almost complete barrenness.

It is probable that so far north as Spitzbergen it is always freezing in the shade, even during the hottest day in summer—from the moment in fact that the sun's rays are not actually shining directly upon an object. On the sunlit side of a hill therefore, it may be quite hot, while on its shaded portion many degrees of frost prevail. This is clearly shown by the perfectly antiseptic condition of the atmosphere which always exists there, it being well known that at a temperature of 32° F. or below it, putrefactive fermentation is arrested. Where severe frost therefore prevails, food supplies of all kinds will keep good for an indefinite period. Thus in Russia during winter they expose piles of carcases of oxen, pigs, etc., for

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sale in the markets, which keep as well as so much firewood while the cold weather lasts. Again, a cask of flour buried on Chamisso Island in the high arctic regions by Captain Beechy in 1826, was perfectly sound and fit for food when disinterred in 1848, and even the iron hoops of the cask were not rusted.*

Captain Scoresby also says that wood has been found in Spitzbergen which had resisted all injury from the weather during the lapse of a century,† and M. Bleau, in his "Atlas Historique," mentions that the bodies of seven Dutch seamen, who had perished there in 1665, were found 20 years afterwards in the most perfect state of preservation. Lord Dufferin also, in his "Letters from High Latitudes," records the fact that in Magdalena Bay, Spitzbergen,

"there are to be seen, even to this day, the bodies of men who died upwards of 250 years ago, in such complete preservation that when you pour hot water on the icy coating which encases them, you can actually see the unchanged features of the dead, through the transparent incrustation." §

It is quite possible that these may be the same bodies mentioned by M. Bleau, and there seems no special reason to doubt that they may thus continue to be preserved, without alteration, even for centuries to come. There is the well-known case, for instance, of bodies of the extinct Mammoth (*Elephas Primigenius*) and Rhinoceros (*R. Antiquitatis*) found on the banks of the Lena River in Siberia, preserved in an almost

* *Zoology of the Voyage of H.M.S. Herald*, by Sir John Richardson, Edited by Professor Forbes, F.R.S., 1854, p. 8.

† *The Arctic Regions, their Appearance, Climate and Zoology*, by Capt. Wm. Scoresby, 1849, p. 115.

§ *Letters from High Latitudes*, by Lord Dufferin, 1858, 4th Edition, p. 221.

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unchanged condition, which Professor Nordenskiold thinks may have lived hundreds of thousands, or even millions of years ago, the remains of one mammoth being, he tells us, "in so fresh a state, that the eye and trunk were quite visible." *

The fact of frost existing always in the ground in this manner might seem to be incompatible with vegetation of any kind. Nevertheless there are certain classes of plants whose regular habitat is among the everlasting snows. Nearly all our principal grasses, for instance, have their arctic representatives, and also a good many of our hardier wild flowers. There is the arctic birch, of which we have already spoken, and two or three varieties of very dwarf willows, the most arctic being a mere creeper, two or three inches high, and a considerable number of valuable lichens, mosses, saxifrages and other rock plants, whose hardy natures enable them to brave the storms and extraordinary rigours of an arctic climate. Here again we are met with one of those wonderful and beautiful provisions of Nature, examples of which are eternally before the eyes of every careful and intelligent observer. The snow, which buries all these regions deep beneath its dreary shroud, serves as a shield and covering to protect these little plants from the biting influences of intense frost, and from the wintry blasts, which might otherwise extinguish their feeble flame of life. They are so constituted as to be unaffected by the immense period of darkness in which they pass nine or ten months out of the twelve, and throughout which vegetation is mostly suspended by a profound and death-like

* *Voyage of the Vega*, by Professor A. E. Nordenskiold, 1881, Vol. i, p. 441.

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slumber, that continues until the moment when they again emerge into daylight and sunshine. Then, as we have already explained, they immediately awake, like a child aroused from sleep, and vegetation pushes forward with great rapidity during the brief summer season. Were it not for the covering of snow, however, it is probable that frost would penetrate with such intensity into the ground, that it would remain almost constantly in such a state of iron-like congelation that most of the arctic plants would gradually perish, but botanical research shows that though the number and variety of the arctic flora are few in comparison with other and more favoured regions, still that quite a long list of plants have been ascertained to maintain existence there, for the *Encyclopædia Britannica*, in a summary of the results obtained thus far, states that—

"there are 762 flowering plants and 925 cryptogams, within the arctic circle, making a total of 1687 plants. Lapland contains by far the richest flora, amounting to three-quarters of the whole, while three-fifths of the species found in Arctic Asia and America also belong to Lapland." *

This however is only what might have been expected, seeing the wonderful fertility of portions of it, to which we have already called attention.

We do not propose to weary our readers with any technical description of arctic flora, but shall merely remark that among the common flowers and plants of our own country, which have their representatives in these northern regions, are the dandelion (*Taraxicum Dens Leonis*), a poppy (*Papaver Nudicaula*), three species of ranunculus, and several of our meadow grasses.

* *Encycl. Brit.*, 9th Edition, Vol. xix, p. 328.

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Among others there is an arctic poa, an arctic foxtail, and an arctic fescue, besides rushes of several sorts; also several berry-bearing shrubs and plants which grow remarkably well in Lapland, such as the juniper, crowberry, bilberry, and the Alpine strawberry. Then as a spice there is the aromatic caraway-seed (*Carum Carui*), also the highly flavoured herb Angelica (*Archangelica Officinalis*) used by confectioners. Among the valuable mosses or nutritive lichens which partake of the character of mosses, we may mention the well known Iceland moss (*Cetraria Islandica*) and reindeer mosses (*Cladonia Rangiferina* and *C. Gracilis*); while as the commonest and chief of the most arctic flowering and forage plants we have the wonderfully hardy "Saxifraga Oppositifolia" deserving of special mention. It is supposed to be upon this plant that the arctic hare and grouse and very likely the musk ox mainly subsist, and it is known to grow as far to the north as arctic explorers have gone, and probably goes to the pole itself, if there are lands there.

As regards the arctic fauna, they are of course, like the flora, comparatively few in number; besides the beasts of prey, such as the polar bear (*Ursus Maritimus*), which lives mostly on seals and fish, the arctic fox (*Vulpes Lagopus*), and the marten (*Mustela Erminia*), there are the reindeer (*Tarandus Rangifer*), the musk ox (*Ovibos Moschatus*), the arctic hare (*Lepus Glacialis*), and the lemming (*Myodes Torquatus*), each of which deserves a short passing notice at our hands.

From our earliest days, the picture of the Lapp, in his robes of fur, drawn in his sledge by reindeer across the snowy wastes, has been present to all our imagina-

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tions, and large herds of these useful animals are still kept by these primitive people throughout the arctic provinces of Europe, much as cattle are kept in England. During the summer they mostly retire to the higher fjelds, but in autumn and early winter are often seen in considerable numbers near the coast, accompanied by herds of deer. The reindeer is to the Lapp what the buffalo was to the Prairie Indian of America, and what the camel still is to the Arab—a friend, a beast of burden, and the source from whence nearly all their needs are supplied, as for instance, milk, cheese, butter and meat, while its skin supplies house and clothing, and its sinews thread to sew with.

In Spitzbergen countless thousands of wild ones still exist, and large numbers are annually killed for their skins. So numerous do reindeer still continue to be there, in spite of the waste of life caused by the inroads of Russian and Norwegian hunters, that it is supposed that their ranks must be recruited by fresh herds descending during the early part of the winter from some unknown continent, existing to the northwards, amid the solitudes of the Palœocrystic seas.

There are a number of circumstances which seem to point to the probability of such a territory being in existence, many of these apparently wild deer appearing to have their ears cut off at the same level, as if it were the work of men, done for the purpose of marking their own stock, and in a way that is different to the practice of any known tribe on the mainland of Europe or Asia. There is also the known immobility of the ice barrier to the eastward of Spitzbergen, which would enable deer to travel across the sea in that

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direction, while it would of course act as an effectual check against the entrance of ships; moreover the broken and hummocky nature of the ice field has hitherto to a great extent baffled the efforts of sledging parties to penetrate any very great distance among this ancient ice, though such difficulties would probably not be sufficient to stop the advance of migratory deer. There are the further facts of flights of birds being observed coming from the north east, which is of itself a strong indication of the existence of land somewhere in that quarter, and also the occurrence of stained and dirty ice also seen in that direction, apparently as if it had been in contact with the land: all of these "together with other minor considerations, of a more general character," * according to the *Encyclopædia Britannica*, seem strongly to support this theory, of the truth of which the Spitzbergen hunters are, it states, strongly persuaded, so much so that they feel confident these great herds do descend, as stated, from some unknown continent, situated in a north-easterly direction.

The Spitzbergen group itself consists of six large and a number of smaller islands, the chief of them being West Spitzbergen, which has an area of nearly 15,200 square miles, and which is mostly of a mountainous character, high mountains reaching 4560 feet covering its southern part. † The whole of the Spitzbergen group are, however, of a very barren, rocky nature, and therefore to all appearance unable to afford subsistence to the immense herds of deer which have been met with there. At first sight it would certainly

* *Encycl. Brit.*, 9th Edition, Vol. xxii, p. 409. (Art. "Spitzbergen").
† *Ibid.*, p. 408.

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seem to be improbable that a supposed inhabited continent, better able to support large herds of heavy game, should exist still further to the northward, while Spitzbergen should be itself uninhabited, as it is, except during the summer time, when the sealers and hunters temporarily resort there.

Nevertheless, on account of the increased length of the period during which the midnight sun continues above the horizon, as the pole is approached, it is not impossible that lands may exist in that direction which might enjoy a richer vegetation than that existing in Spitzbergen, where the soil is all barren rock and gravel; while at the same time the condition of the ice is sufficient to account for the failure of explorers to discover these territories, should they have any existence.

It must also be borne in mind that we know little or nothing of the habits of animals inhabiting these far northern regions, or of the means by which they find subsistence. All we know is that such animals do exist. Yet it looks as if there was nothing for them to eat, and as if every living thing overtaken there by the winter must of necessity die of starvation. We shall, however, hope to show that this is an entire misapprehension of the facts.

In Spitzbergen, for instance, multitudes of reindeer undoubtedly exist, of such magnificent proportions that, according to Professor Nordenskiold, who had ample opportunities of observing them, their "forms appeared colossal when contrasted with the tame reindeer the Swedes are accustomed to." * Yet these splendid animals

* *Arctic Voyages of the Vega*, by Professor A. E. Nordenskiold, Translated by Alex. Leslie, 1881, p. 199.

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not only exist but flourish and grow exceedingly fat upon these apparently completely barren shores, which seem in many places entirely destitute of vegetation. Upon the first arrival of the hunters, at the beginning of the summer, the deer which have passed the winter in Spitzbergen are found to be thin and in poor condition, but though "much emaciated in June, they grow very fat towards the end of the autumn, after feeding on the mosses." *

With regard to this, Professor Nordenskiold says, that "two were shot early in October 1872, by the Swedish Polar Expedition, with the carcase covered with a thick layer of fat," while in the month of September these splendid deer "resemble fat cattle, and have their flesh so surrounded with fat, that it is nearly uneatable." †

These are remarkable facts which it would seem hard to account for, but the Professor goes on to observe that the well known reindeer moss (*Cladonia Rangiferina*), the natural food of these deer, grows "in large quantities under the snow in Spitzbergen, and other high latitudes: and when reindeer can get this they require no other food." § That being so an immediate explanation of this apparently strange phenomenon is at once supplied, as it is exactly upon these bare rocks and stones that this curious nutritive lichen thrives best. It is called a moss, but it is really a true lichen, ** and from its silver-grey stone colour it is not easily seen afar off, as it much resembles the colour of the surrounding rock. It is only on walking

* *Encycl. Brit.*, 9th Edit., Vol. xxii., p. 409.
† *Arctic Voyages of the Vega*, by Professor Nordenskiold, 1881, p. 199.
§ *Ibid.*
** See *Encycl. Brit.*, 9th Edition, Vol. xiv, p. 560. (Art. "Lichens").

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among rocks covered by it that one sees that they are carpeted with a thick covering of this plant, which a stranger ignorant of its nature would certainly never imagine to be an excellent and nourishing food.

Reindeer are also known to be animals of a very migratory nature. The tame Lapp deer, for instance, has to be constantly changing its feeding grounds, and the habits of their owners have to be governed by the necessities of their deer. In summer, for instance, like the Swiss shepherds, the Laplanders go up with their deer to the high fjelds, and as pasturage becomes scarce gradually descend to the lowlands, to wherever wild land is to be found, and move down as the winter advances to more southern districts, while later on during spring they go to the neighbourhood of the sea. It is said that these tame deer can "draw about 300 lbs. and are able to travel without difficulty 100 miles a day over the frozen snow, their broad, deeply-cleft hoofs being admirably adapted for travelling over such a surface." * We can thus understand how it would be possible for them to travel quickly from the far North, though men encumbered with heavily laden sledges might not be able to make much headway.

The Caribou, or wild American variety (*Rangifer Caribou*) is likewise known to migrate in vast herds into the northern wilds during summer, returning again in winter to more temperate regions, and the Hudson Bay Voyageurs relate wonderful stories of the almost incredible distances they will accomplish in the 24 hours. Mr. Warburton Pike, who witnessed one of their migrations in October 1889, from the barren

* See *Encycl. Brit.*, 9th Edition, Vol. vii., p. 24. (Art. "Deer").

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grounds of Northern Canada, has given a most graphic description of the scene, which occurred near the great Slave Lake. Scattered bands were almost continually in sight from its commencement, he says, which rapidly increased in numbers until October 20th, when he was aroused by his men with a cry of "La Foule—La Foule!" The great army of migratory deer were indeed upon them, having suddenly arrived like a thief in the night.

"We could hear (he says) the clatter made by a band of travelling caribou. 'La Foule' had really come, and during its passage of six days, I was able to realize what an extraordinary number of these animals still roam in the barren grounds. All the south side of Mackay Lake (a sheet of water to the north of the Slave Lake) was alive with moving beasts, while the ice seemed dotted over with black islands, and still far away on the north shore, with the aid of glasses, we could see them coming like regiments of infantry on the march. The snow was broken into broad roads, and I found it useless to try and estimate the number that passed within a few miles of our encampment. The buffalo were all, for the most part, killed out before my time, but notwithstanding the tall stories that are told of their numbers, I cannot believe that the herds on the prairie ever surpassed in size 'La Foule' of the Caribou." *

These great migrations among wild animals are strange and remarkable phenomena, which occur in almost every part of the world where large areas of wild lands exist. Sometimes they are caused, as in these far northern regions, by the rigour of the climate; at other times, as in arid countries bordering on the tropics, they are caused by the drying up of the

* *The Barren Grounds of Northern Canada*, by Warburton Pike, 1892, pp. 82, 83.

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waters. The great migrations of the buffalo to which Mr. Pike alludes and which formed such wonderful spectacles in former days, probably arose from both these causes, while the still more marvellous migrations of the springbok, in South Africa, were undoubtedly due to the failure of the water supply and the drying up and withering of the vegetation. In equatorial regions, again, very often it is the fly which drives everything before it, as effectually as the descent of the arctic snows. But it is probable that wonderful as these migrations of mighty herds of game animals certainly are, they really, if we look at the matter aright, are far surpassed as curious natural phenomena, by the still more remarkable migrations of birds which literally seem to traverse the broad surface of the earth, by land and sea, from the equator to the poles.

The migrations of animals can almost always be traced to some self-evident cause, such as the imperative necessity for a move, created by some of the causes we have mentioned above; and in our sections on forest and jungle shooting, and hunting and stalking on plains, we hope to be able to quote a number of striking examples of such cases. But the causes which impel the migrations of birds are much more complex in their origin, so that it is not always easy to assign a reason which accounts satisfactorily for the immense flights periodically undertaken by some of these frail and tiny creatures.

Why should the swallow, for instance, which is seen throughout the winter in the interior of Africa, at the Cape of Good Hope, Australia, New Zealand, etc., suddenly wing its way as far north as Lapland and even to the stormy coasts of the arctic seas? The

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fly-line of this migratory bird is estimated by ornithologists as extending for distances varying from 7000 to 10,000 miles. *

Why should the wild goose, as soon as the first indications of spring begin to appear, take its flight from places where food is abundant, and fly towards the polar seas, arriving there with the first movement of the ice, and keep pushing on further and further to the north, amid the regions of eternal snow, wherever a patch of open water may appear, until, as far as human knowledge goes, it seems probable they may possibly reach the pole itself?

It is generally supposed that they are inspired by an instinctive desire to be able to rear their young in safety, amid these icy solitudes, far from the reach of human or other enemies. But are there not vast areas of wild land much further south where, in a less rigorous climate, they might rest as securely as at the pole itself? It will be apparent that in neither of these cases, can the search for food, the flight from the reach of possible enemies, nor the fear of heat or cold, quite account for the vast flights which these birds undertake; seeing that all these objects would be obtainable elsewhere with much less labour and difficulty, and a far less distant flight.

Now it is specially in the Arctic Zone that these curious phenomena, respecting the distant migrations of bird life, can be witnessed on the most extensive scale and under the most peculiar circumstances.

During the long night of an arctic winter, these dreary regions are, with some few notable exceptions,

* See *The Migration of Birds*—An Attempt to reduce Avian Season-Flight to Law. By Charles Dixon, 1891, p. 57.

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which we shall endeavour to deal with presently, entirely abandoned by almost every kind of feathered fowl. When the great snows of autumn begin to fall, and frost has laid its iron grasp upon the waters, fast closing them for a period of many months—want of food, and even of water, as a general rule, forces these visitors to seek refuge from the rigours of the winter, in the milder climates of the south. But no sooner does the sun reappear than they are back again, seeking an entry into the northern wilds, and patiently waiting for the appearance of open water; and in summer time, certain land areas of the great arctic wilderness would form a regular hunter's paradise were it nor for the intolerable plague of mosquitoes, and other flies, which infest it. The vast numbers of birds of many kinds that then resort to these regions, have been noted with astonishment by most travellers who visit arctic lands; and among the first and chiefest arrivals among the birds, we may mention the arctic geese.

On the eastern seaboard of North America many of the geese winter as far south as the southern coasts of the United States—the Chesapeake for instance in its central parts has always been a celebrated resort for wild fowl of almost every kind, but with the opening of spring the geese are back as far north as Canada again. In New Brunswick for instance, "they make their first appearance about March 17, and remain till the end of May, when they fly to their northern nesting grounds." * Cotemporaneously with these migrations of the geese upon the eastern coasts, the

* *The Emigrant and Sportsman in Canada.* Experiences of an Old Settler, by John J. Rowan, 1876, pp. 112, 113.

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same process is going on across the whole breadth of the great North American continent; for on the great lakes on the Upper Mississippi, and throughout the Hudson Bay territories, the month of May and early part of June is annually marked by the simultaneous flight towards the northward of numerous flocks of wild geese.* These birds mostly consist of the varieties known as the Brent goose (*Bernicla Brenta*), the Bernicle (*Bernicla Leucopsis*), the large Canadian goose (*Bernicla Canadensis*), the snow goose (*Anser Hyperboreus*), and the White-fronted or Laughing Goose (*Anser Albifrons*). When in the Hudson Bay Territory some thirty years ago, we were informed by the Company's officers that both in autumn and spring the migratory flights of these birds often continued without interruption for days together. They generally fly by easy stages, settling down for rest, either upon the ground, or upon open water, where vast flocks, many thousands in number, may sometimes be seen herded together; the extraordinary noise they make on these occasions is sometimes almost deafening; at other times it resembles the sound of an immense pack of hounds in full cry. Should anything disturb them, the sound of their myriad wings, as the whole flock suddenly takes to flight, exactly resembles a roll of muffled thunder; while a vast volume of discordant cries fills the whole air, and is often audible for miles away, as the great assemblage sails away upon its distant journey. The different kinds of geese generally keep together as much as possible, and their flights therefore vary a

* See with reference to the Great Migrations near the great Slave Lake, *The Barren Grounds of Northern Canada*, by Warburton Pike, 1892, p. 161.

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good deal in point of time, some kinds arriving earlier than the others.

Among the earliest arrivals of the northern geese, the Brent is always conspicuous, and it is probable that these birds go all the way to the pole, if there is any land there, which appears to be almost certain, judging by the constant flights of these and other birds towards the far north, beyond the furthest limits ever yet attained by man. Sir George Nares for instance mentions that in 1876 parties of Brent geese arrived in the vicinity of the winter quarters of the *Alert*, as far north as Lat. 82° 33′ N., in the first week in June, but they were very wary, and kept well out of shot; and on the 21st he states that a nest was seen. * A little later, "on August 4th, 57 goslings which had not yet learned to fly, were shot by the expedition. † Concerning the migrations of geese in the antarctic regions, of course we know comparatively little, but enough is known to show almost beyond a doubt that similar great migrations of these birds take place there on an enormous scale. The incredible numbers that used to frequent the Falkland Islands, during quite recent years, for instance, is a matter of ascertained historical fact; we are however indebted to Mr. Hudson for the latest account of the autumn arrivals of migratory geese upon the Rio Negro, on the borders of Patagonia. The arrival there early in winter of vast flights of the Upland geese (*Chloephaga Magellicana*) was, he says, positively *dreaded* by the people; for it is scarcely possible to keep them from the cul-

* *Narrative of a Voyage to the Polar Sea*, by Capt. Sir Geo. Nares, R.N., 1878, Vol. ii., p. 216.

† *Ibid.*, Vol. ii., p. 124.

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tivated fields; the injury they do to pasture lands is even more extensive, for the geese

"are often so numerous as to denude the earth, thus depriving the sheep of their food. On some estates (he continues) mounted boys were kept, driving up the flocks with loud shouts, but their labours were profitless: fresh armies of geese, on their way north, were continually pouring in, making a vast camping ground of the valley, till scarcely a blade of grass remained." *

In the northern hemisphere the arrival of the geese in the arctic regions is quickly followed by the appearance of innumerable flocks of birds of various descriptions, which are for the most part arriving after migratory flights of many thousand miles, to rest amid these northern wilds. For a considerable distance after crossing the arctic circle, the barren grounds which extend in this region right across the great continents of Europe, Asia and America, are known to consist for the most part of lakes and swampy moorlands; and except in Greenland there is also, in all these lands adjacent to the arctic circle, an immense area of country dotted over here and there by dense thickets of bush, which affords admirable shelter for the numerous feathered tribes of land birds, which in addition to the myriads of water-fowl, arrive in such numbers that the Arctic Zone at this season becomes a veritable museum of natural history for the ornithologist; while it also offers a comparatively untouched, and almost boundless field of investigation to the botanist.

The transmutation which is produced by the sudden break-up of the arctic winter, and the almost immediate change to summer, is of so rapid and wonderful

* *Idle Days in Patagonia*, by W. H. Hudson, C.M.Z.S., 1893, p. 61.

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a nature, that it is certain that no other phenomena in Nature can be compared to it. Ever since the settlement of civilized man upon its banks, for instance, the breaking up of the ice upon the St. Lawrence has proved a constant source of never-failing wonder to the whole Canadian population; and from time to time a multitude of writers have vainly endeavoured to give an adequate description of its grandeur; and yet what is the break-up of the ice upon a single river, when compared to the mighty, and almost simultaneous revolution of Nature, which takes place every spring over the whole extent of the southern portion of the arctic ocean, and the numerous great rivers which flow into it?

To what shall we attribute this stupendous convulsion of whose magnitude the human mind can hardly realize the faintest idea?

Are we to seek for an explanation of it through a combination of several causes, or must we regard it merely as the result of the sun's rays shining upon the arctic solitudes after a perpetual night of some months' duration?

We know that on the American plains for example, as long as the wind is from the north, and the temperature in consequence keeps low, there may be very powerful sunshine for many days in succession, without doing more than merely encrusting the surface of the snow with a thin film of ice. We are inclined to think therefore, that great though the sun's influence in this respect may be, it would be insufficient of itself alone to produce this sudden and marvellous change, which we believe is principally due to a change of wind which produces a rapid rise in the temperature

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of the whole atmosphere, while the existence of continuous day prevents the refrigeration which would otherwise occur by night, and thus, when the southern wind blows softly, the great disruption of the northern ice is brought about.

We ought here to make a short digression from our narrative to say a few words upon the scientific aspects of snow in its effects upon climate. Rains, as we know, produce no permanent effects upon temperature; in cold countries especially, their effects soon pass away, as the water runs off—and in no case, however heavy may be the rainfall, do they produce any permanent rise in the general level of the waters. But the effect of snow on the other hand, is constantly cumulative, so long as it continues to fall. A very heavy and long continued snow-fall may in this way therefore accumulate in such masses that the warmth of the whole of the following summer may be unable to melt it. This occurs upon high mountains all over the world, where a regular line of perpetual snow becomes more or less constant. In the tropics for instance, this may, as we have shown, be roughly located at an elevation of about 16,000 feet above sea level.

When this takes place, as Mr. Wallace has pointed out, *cold* is rendered permanent, no amount of sun-heat prevailing to warm the air, or earth, much above freezing-point.

"The quantity of heat (he goes on to explain) required to melt ice or snow is very great. To melt 1 cubic foot of ice, as much heat is required as would heat a cubic foot of water from the freezing point to 176° Fahr., and to melt a layer of ice only 1½ inches thick, requires as much heat as would

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raise a stratum of air, 800 feet thick, from freezing point to the tropical heat of 88° Fahr." *

Masses of heavy snow therefore are possessed of great immobility, and melt but slowly under the action of sunshine in consequence of their great power of *reflecting* heat, and so dispersing it into the atmosphere; so much so, that even in Great Britain, after winters when the snowfall has been exceptionally heavy, and drifts of considerable depth have formed in sheltered places, among hills, unmelted patches of snow are sometimes visible well on into the spring. This permanent storing up of cold in the form of snow is therefore capable, under certain circumstances, of producing extraordinary effects in the physical geography and climate of countries, as is at present exemplified in the constantly snow-covered condition of Greenland and of South Georgia and Sandwich Island in the South Pacific; while other places considerably nearer to the pole possess a vegetation of comparative and even extreme luxuriance, though their summers are necessarily shorter, and also the cold of the winters probably more intense. The permanent storing up of cold therefore, Mr. Wallace has pointed out,

"depends entirely on the annual amount of snowfall in proportion to heat, and not on the actual cold of the winter, or even the average cold of the year. A place may be intensely cold in winter, yet if little snow falls there is nothing to prevent the summer being hot, and the earth producing luxurious vegetation." †

There are however some northern countries where

* *Island Life or Insular Faunas and Floras and Geological Climates*, by Alfred R. Wallace, 1880, p. 30.

† *Ibid.*, p. 30.

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the snow lies deep, and the rivers are all fast closed by ice of great thickness. And was all this amount of stored-up cold suffered to remain until it disappeared under the influence of sunshine, it is to be feared that vast areas would become buried like Greenland under a permanent ice cap. In these cases the release of the land from the iron grip of winter is undoubtedly due to the setting in of warm winds, which act which almost magical power in producing the mighty upheaval of the ice-closed rivers and the melting of the great snow drifts.

Mr. Seebohm, in his account of the break-up of the winter in eastern Siberia has supplied us with a striking description of this great event, which was witnessed by him in 1882, upon the Yenesay River, a gigantic stream some three or four miles wide, which there flows into the Arctic Ocean.

"Early in June (he says) the sun only touches the horizon at midnight, and for a few days you have the anomaly of unbroken day in midwinter. Then comes the south wind; and often rain; and the great event of the year takes place—the ice on the great rivers breaks up; and the blanket of snow melts away." *

With reference to the immediate and almost miraculous change thus brought about, Mr. Seebohm states his opinions about it in these words, to which we think it unnecessary to add a single observation:

"This sudden change, in the space of a fortnight, from midwinter to midsummer, can (he observes) scarcely be called spring. It is a revolution of Nature, so imposing, that the most prosaic of observers cannot witness it without feeling its

* *Siberia in Asia:* a Visit to the Valley of the Yenesay in East Siberia, with a description of the Natural History etc., by Henry Seebohm, 1882, p. 192.

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sublimity. The white snow seems to be an invulnerable shield against which the sun-darts glance harmless, and are reflected back into the air. On the contrary the south wind seems all powerful. In the midst of mist and cold, the snow melts before it like butter upon hot toast; and winter tumbles down like a pack of cards." *

And yet, he says, this wonderful transformation, "the silent upheaval of the gigantic river four miles wide, and the smash up of the six feet of ice upon it," is to his mind surpassed in interest, and as a marvellous phenomenon of Nature, by the arrival of the migratory birds. Until then, these snow-clad wilds are deserted by almost every trace of life, and silent as the grave; but all at once, like a shift of scenery upon the stage of a theatre, the wilderness is now made bright with the bursting forth of verdure and the general resurrection of vegetable life; whilst on every side the voice of the bird is heard filling each copse and thicket with melody; and covering every newly formed pool of water, with multitudes of these graceful creatures. The breaking up of the ice is indeed a majestic display of power, "but for all that (says Mr. Seebohm) the arrival of the migratory birds so suddenly, and in such countless numbers, appeals more forcibly to the imagination, perhaps because it is more mysterious." †

The first rush of these migrants takes place the very moment the ice and snow begins to melt, and "every little oasis of land in the vast desert of snow is soon full of birds"—first a few pairs, rapidly succeeded by

* *Siberia in Asia:* a Visit to the Valley of the Yenesay in East Siberia, with a description of the Natural History, migration of birds, etc., by Henry Seebohm, 1882, pp. 100, 101.

† *Ibid.*, p. 193.

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large flocks of almost every kind of fowl. It would be too long to attempt anything more than a description of them in the most general terms:—there were wagtails, willow warblers, chiffchaffs, thrushes, ouzels, bramblings, white-fronted geese, cuckoos, snipe, plovers, pipits, bullfinches, besides a vast variety of water-fowl and sea birds of every description. *

"The revolution in the ice (says Mr. Seebohm) took place to the accompaniment of a perfect babel of birds. Above our heads we continually heard the 'gag-gag' of geese and the harsh bark of swans, as flock after flock hurried past us to the Tundra. Where there was a little water between the ice floes, crowds of gulls were fishing; while ever and anon the weird cries of the black-throated and red-throated divers came from the creek; flocks of wild ducks also passed, and along the shore, small birds flitted from bush to bush." †

These brief extracts culled from the thoughtful work of Mr. Seebohm, present to the mind's eye a wonderful picture of the great spring migration in the Yenesay region, even had it stood alone: but it must be remembered that we are here recording merely the experiences of a single man stationed at a single point in the immensity of these great northern solitudes; and that the same process is simultaneously going on *almost everywhere* throughout the wide expanse of each of the great continents of the northern hemisphere; though it may be that the fly-lines along the courses of great rivers may be more largely used by birds than other places—still the flights that may frequently be seen going across

* *Siberia in Asia:* a Visit to the Valley of the Yenesay in East Siberia, with a description of the Natural History, migration of birds, etc., by Henry Seebohm, 1882, pp. 102—111.

† *Ibid.*, pp. 96, 97.

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country show that these migrations are, as we have said, in progress over almost the whole country generally, and are as general (if we may venture to use the simile) as the snow-flakes which fall over vast areas, during the occurrence of extensive atmospheric disturbances.

We have already noticed certain facts which prove that these migrations occur in both the arctic and antarctic regions, so far as the evidence of facts upon the American continent is concerned, and it would be possible to collect evidence to show that in all probability they take place periodically almost everywhere upon the whole terrestrial surface of the globe. * Exact observations upon these and similar matters are however as yet comparatively scanty; as it is only of late years that these interesting phenomena have been made the subject of systematic investigation.

In the first place, the flight of migratory birds takes place for the most part by night, when their movements are not easily observed. It frequently occurs that the only evidence of their passing above is the sound of their different call notes; and even in the daytime the vast altitude at which they fly frequently renders anything like exact observations impossible, for it seems probable and indeed certain that many of the smaller species pass at such great heights above the earth that under the most favourable circumstances they are entirely beyond the range of human vision. †

It is probable that a number of causes combine to induce birds to ascend to these great heights during

* In Australia and other southern lands for instance, enormous flights of wild-fowl are constantly seen during their autumns and springs.

† *The Migration of Birds*, an Attempt to reduce Avian Season Flight to Law, by Charles Dixon, 1892, p. 71.

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their migratory flights. Among others, the desire to conceal their movements, and place themselves above the usual haunts of birds of prey, and other enemies; then again, the stiller, and cooler condition of the higher atmosphere, and the fact that birds flying at great altitudes can see to much greater distances ahead, are doubtless all causes which influence their movements. Mr. Dixon, in his valuable monograph on the migration of birds, expresses himself strongly impressed with this view, and says,

"In my opinion the vast importance of altitude in migration has never been recognised. Without considerable altitude the migration of many birds would be simply impossible, and that most birds fly unusally high during migration is, I think, an unquestionable fact." * "The mere mechanical labour of flight is rendered much easier of performance in the more rarified atmosphere of these lofty regions of space. The currents of air at great altitudes may also be more uniform and favourable." † "The more I study migration," Mr. Dixon proceeds to say, "the more I feel convinced that there is a nocturnal drama in the air, of which only a faint conception of its wonders can be formed by terrestrial scrutiny. Many a time, the only sign on earth that a great migration is in progress is by hearing the varied and often repeated notes, sounding faintly from on high, as the armies of birds pass on in the darkness overhead." §

The punctuality with which these periodical flights are accomplished, almost upon the very same day, each season as it comes round, is also one of their most extraordinary and remarkable features; and we need make no apology to our readers for transcribing

* *The Migration of Birds*, an Attempt to reduce Avian Season Flight to Law, by Charles Dixon, 1892, p. 77, 78.

† *Ibid.*, p. 83.

§ *Ibid.*, p. 85.

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another paragraph from Mr. Dixon's interesting work with respect to it:

"The punctuality of arrivals of birds (he says) at their summer or winter quarters is nothing less than astonishing. Taking into account the length of the journey, and the consequent number and variety of possible causes of delay; the best kept time of the crack expresses, or fastest ocean steamers, absolutely suffers by comparison. The one hour late in the 200 miles run of an express, or the 24, in the 5000 miles voyage of a steamer, is certainly a far worse record than the one day late in the 5000 miles, or the couple of days in 10,000 miles flight of a bird, at the mercy of countless contingencies neither the train nor the boat have to battle with. And yet, this is a simple statement of facts. Migratory birds may be looked for almost to the day, as anyone can prove, by keeping a record during a series of years." *

There can we think be little doubt that these observations of Mr. Dixon are strictly borne out by fact, and that not only do the birds beat the best human records in point of punctuality, but also enormously exceed them in rapidity. We have been at some pains to look up the latest reliable data which have been recorded with respect to the highest speed as yet attained by trains; which, on the authority of *The Scientific American*, we find is given at 112.5 miles per hour, accomplished by the New York "Empire State Express," and that it was hoped shortly to beat that record by running a mile in thirty seconds, † that would be 120 miles per hour. But these great speeds, we need hardly say, are only kept up for short distances, on a selected stretch of perfectly level

* *The Migration of Birds*, an Attempt to reduce Avian Season Flight to Law, by Charles Dixon, 1892, pp. 71, 72.

† *Engineer* (London) of June 2, 1893, p. 471.

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line, as a sort of advertisement for the railway—whereas the flight of birds is kept up hour after hour, at infinitely higher rates of speed.

We fear there are no means available for stating authoritatively what these speeds are, with any degree of accuracy; but it is generally considered that for some of the stronger birds from 100 to 200 miles an hour is by no means uncommon; and that the highest of these speeds is exceeded by some birds.

Thus, Herr Gätke, whose splendid work on "The Birds of Heligoland" ought to be in the library of every lover of natural history, considers that a speed of up to 216 miles per hour has been attained by the Virginian Plover (*Charadrius Virginicus*), and a velocity of 180 miles an hour by a small song-bird of uncommon beauty, and coming nearly up to the nightingale in the tunefulness of its song, the Northern Bluethroat (*Sylvia Suecica* [Linn.])." * According to the same authority, large flocks of the Virginian Plover annually perform an unbroken flight of 3000 miles and upwards, from Brazil to Labrador, across a continuous surface of ocean; their migration columns being constantly seen passing Bermuda, containing countless thousands of birds. †

There are however other authorities on ornithological science who assert that these enormous flight-speeds are much exaggerated and who regard the arguments in their favour as based on fallacious data. All that

* *Heligoland as an Ornithological Observatory*. The result of 50 years experience by Heinrich Gätke, translated from the German by Rudolph Rosenstock, 1895, pp. 266 and 470, 471.

N.B.—Many valuable details upon the subject of Bird Migrations occur in this work, well deserving of being richly studied.

† *The Naturalist in Bermuda*, by J. M. Jones.

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we shall venture to say on this head is, that the opponents of the high speed theory are met with difficulties quite as great as those which beset its supporters. The evidence for and against these rival claims has been shortly and well summarized in a letter which appeared in *The Field* newspaper, as follows:

"Take the case of the Blue Throat—if it does not go at the alleged rate of miles per hour, it must be capable of a sustained flight of some 40 hours—quite as incredible a statement as that with regard to speed. Again, with the plovers that are not found anywhere on the American coast between Labrador and Brazil —3000 miles—at what rate is this carried out? By diminishing the speed we get into the difficulty of time. A bird may possibly be able to float for days in the air, without food or rest, but if so, that is at least as startling a novelty as Herr Gätke's extraordinary speeds." *

It is in fact obvious that if (at least) 3000 miles of ocean has to be crossed at the high speed of 216 miles per hour, it will take 14½ hours, or thereabouts to accomplish the journey; whereas if the bird only flies at the rate of 50 miles an hour, it will require 60 hours to perform the same distance. We leave the reader therefore to form his own conclusions, as to which side the balance of probabilities seems to incline.

The destruction of life among the feathered tribes during their migrations is, as might be expected, enormous. When we say that, it conveys, we fear, but a very vague idea of what those few words import: or of the countless myriads of these graceful and delicate creatures which meet their deaths by it.

* Extract letter signed T. M. Pike in *The Field* of Nov. 23, 1895, p. 833.

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As Mr. Dixon points out, the death-rate of a large town standing at 50 or 60 per 1000, creates something like a panic among its human inhabitants (the average death-rate of London for the whole year for instance is only 19.7 per 1000 *); but Mr. Dixon thinks "there can be no doubt whatever that the death-rate among birds, during migration, reaches 500 or 600 per 1000, and during exceptional circumstances very much more," and "few there be that survive it." † Indeed of the innumerable legions of birds which leave their nesting grounds in the Arctic Zone, and fly towards the south at the approach of winter, but a small percentage survives to revisit them the following year. "Only a fragment of these bird swarms (Mr. Dixon thinks), countless, one was going to say, as the sands on the shore, returns in spring." §

The perils of migration, according to the same authority, may be divided into three important classes. Fatigue, natural enemies, and blunders and fatalities by the way; of which probably the first is the most fatal; but for further details on this subject we must refer the reader to Mr. Dixon's monograph.

We have gone into details with reference to the migration of birds in this section, because we think that it is in the Arctic Zone that peculiar opportunities exist for investigating this subject, and because it is these high latitudes that are the objective of the longest flights performed by migratory birds; in accordance with the law now almost universally recognised among ornithologists, that "as a general

* Returns issued by the Registrar General for the year ending September 26, 1892.

† See *The Migrations of Birds*, by Charles Dixon, 1892, pp. 168, 169.

§ *Ibid.*, p. 159.

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rule amongst regular migrants, the further North a bird goest to breed, the further South it goes to winter." * Both Mr. Seebohm and Mr. Dixon enter into numerous details to prove the truth of this assertion—which is held by both of them to be strictly in accordance with known facts; but space forbids us to do more than to indicate the works of these authors, to which the reader may refer for further information on the subject. †

To many persons it may appear a matter of surprise that delicate creatures such as many birds are known to be—as for instance the swallow, and the sand-martin—should in many cases seek a home, to rear their tender nestlings, amid the rigours of an arctic climate; it must however be remembered that the brief period of summer there is like the bloom upon a youthful cheek, very beautiful and attractive, though fleeting. More than 160 years ago for instance, the great Linnæus, in the journal of his tour in Lapland, recorded his impressions of the climate in these words—

"June 24, 1732. Midsummer's Day. Blessed be the Lord for the beauty of summer, and of spring, and for what is here in greater perfection than almost anywhere else in the world: the air, the water, the verdure of the herbage, and the song of birds." §

So also nearly 150 years afterwards, Mr. H. W. Wheelwright, after alluding to the beauty of the scenery,

* *The Geographical Distribution of the Family Charadriidæ or the Plovers, Sandpipers, Snipes, and their Allies*, by Henry Seebohm, 1888, p. 36.

† Some further details respecting bird migrations will be found in Chapter xviii on Wild Fowl and Wild Fowl Shooting in Vol. iii.

§ *Lachesis Lapponica*, by Carl von Linnæus, translated by Dr. J. E. Smith, M.D., President of the Linnæan Society of London, 1811, Vol. i., p. 244.

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and the vast quantities of bird life still existing in this same region, says:

"Never did I see in any country so much game as in Lapland. The shooter need only wander a few miles from the village (Quickjock) and I am certain that on any day he will be able to shoot more game than he can carry home. For capercailzie, hazel grouse, and willow grouse, the shooter can hardly go wrong. Every fell literally swarms with ptarmigan, dotterel, golden plover, and mountain hare. For flapper shooting in July, Lapland would be hard to beat, for this country is the great breeding ground of half the wild fowl in Europe. Scoter, velvet duck, scaup duck, golden eye, pintail, widgeon, wild swan, bean, and white-fronted geese, flock in hundreds as soon as the ice breaks up to these northern wilds, where they can breed in security far from the haunts of man." *

The more delicate and smaller birds are somewhat later arrivals than these hardy northern wildfowl; but they were there, however, in thousands, just as Mr. Seebohm describes them to have been in North-east Siberia, notwithstanding the intensely rigorous nature of its climate.

Thus far we have confined our observations principally to the migratory birds, which are visitors during a brief period of the year to the arctic regions; causing these solitudes to appear replete with numerous beautiful forms of life, and glad with merry voices of birds. There are however certain kinds of birds and animals which make their permanent home there, and winter amid the drifting snows.

These are the ptarmigan, or snow grouse (*Lagopus Rupestris*)—the arctic hare (*Lepus Glacialis*) two or

* *A Spring and Summer in Lapland* (a bird collector's tour), by Horace W. Wheelwright ("Old Bushman"), 1871, p. 145.

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more kinds of a small rodent, called the lemming (*Myodes Torquatus*), a mouse (*Mus. Musculus*), the marten (*Mustala Erminea*), and the snow fox (*Vulpes Lagopus*). There are also the three larger animals already referred to, which are inhabitants of the Arctic Zone, namely the musk ox, the reindeer, and the polar bear, also in some places a few wolves; but these larger animals do not as a rule winter in the higher latitudes. The white bear for instance usually keeps on the edge of the polar ice, in the neighbourhood of open water, as it lives mainly upon seals, and other food obtained from the sea; and, in the opinion of Sir George Nares, rarely leaves its hunting fields, in Baffin's Bay; and never enters the polar basin through Robeson Channel. *

These animals are still seen in considerable numbers in some parts of the Arctic Zone; and in our sections devoted to shooting some details with reference to the sport of polar bear hunting will be found, which we trust may prove of interest; though as a truly arctic animal, a denizen of the far north, for the purposes of the present section, the white bear possesses fewer features of zoological interest than other habitants of the polar basin.

The musk ox (*Ovibos Moschatus*), one of these creatures, though it must be classed among the fauna of the polar regions, generally descends during winter to the neighbourhood of the arctic circle, where there are woods, and other places in which food is plentiful; nevertheless herds of these curious animals are sometimes met with by arctic explorers, which have evidently wintered in very far northern situations, where it is difficult to conceive

* *Arctic Voyage*, by Captain Sir George Nares, R.N., 1878, Vol. ii, p. 195.

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how they can maintain life during the long polar night, when vegetation is deeply buried in the snows. Little however of a precise nature is known about their habits—and the habits of the musk ox when existing in high northern latitudes may differ considerably from those of the same animal inhabiting the bush near the arctic circle. It is however probable that like the reindeer, the musk ox of polar regions subsists mainly upon certain lichens and mosses, which though not very attractive looking food, are found in vast quantities, we think we may say, in all rocky areas of the Arctic Zone, wherever in fact the rock protrudes above the snow.

The reindeer moss (*Cladonia Rangiferina*) which is as we have said, one of the nutritive lichens of the Polar Zone, in some districts completely covers the rocks, to a thickness of some two inches or so, with a dense bluish grey carpet of a sort of dry hard moss-like growth. The Lapland forests for example are full of it; and its peculiar appearance, together with the long pendant tree mosses of a somewhat similar colour hanging from the branches, imparts to these forests a look of hoary antiquity which is very striking. Wherever this apparently indigestible moss is found in plenty, the reindeer appears to flourish and grow fat; while elsewhere they seldom seem to thrive or keep in good condition. Professor Baron Nordenskiold states with regard to this, that

"it has been well ascertained that reindeer can be fed on grain, arctic grasses, lichens, and rushes, and thrive on them for a while, but cannot go altogether without reindeer moss, for any considerable length of time, without falling off in condition. *

* *Nordenskiold's Arctic Voyage*, pp. 176—200.

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Strange to say, the quality of this moss seems to improve under the action of severe frost, and therefore it is never in better order than during the depth of an arctic winter. At this time of course, it is mostly deeply buried beneath a covering of snow, several feet in depth—and the reindeer and probably also the musk ox are then obliged to burrow for it through the snow, exactly like rabbits. The wild deer at these times are often come upon by hunters, with their bodies entirely concealed in these deep holes which descend in a slanting direction, and from which perhaps the tail or hind quarters of a reindeer project, showing where the animal is steadily working away, and shovelling out the snow, in order to reach the precious food below; large areas of land are often found to be honeycombed with these snow burrows, and in this curious way reindeer manage to sustain life, and even to remain fat and in good condition, in the midst of what otherwise seems a desolate waste of snow, where there would not be nourishment enough for a mouse. We venture to suggest that musk oxen probably obtain their food in this way, when wintering in high northern lands, such as the Parry Islands, or Grinnell Land; the prairie buffalo (*Bos Americanus*) for instance, it has long been known, when overtaken by heavy snows upon the prairies, used to subsist in a very similar way; only it was not with the feet, but with the broad and powerful nose, that they ploughed up the snow until they reached the grass beneath; in this way, old buffalo bulls used sometimes to exist throughout the whole winter on the Saskatchewan and other rivers in the Hudson Bay Territory, where the snow lay several feet in depth for months together; yet it was only

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occasionally that hunters killing one of these bulls found that the nose was excoriated by this constant shovelling, but as a rule, most of their faces bore no trace of injury from the rough work they had undergone. The musk ox is an animal of whose habits much less is known—but according to the *Encyclopædia Britannica* "they feed chiefly on grass, but also on moss, lichens, and the tender shoots of the willow and pine." *

Now in these far northern lands there are to be found many species of lichens. The Arctic Zone in fact is peculiarly the land of the lichen; and upon these, as well as upon dwarf creeping willows, rarely rising over a couple of inches above the surface of the ground, and the snow-loving "Saxifraga Oppositifolia," which is one of the hardiest and most valuable of all polar forage plants, it is probable that the musk ox contrives to glean a frugal livelihood. These curious animals are about the size of small mountain cattle, but are more heavily and powerfully built, and in their structure and habits are closely allied to the sheep. It is thus, and because of the strong scent of musk which they exhale from their skins that they have acquired the name of "Ovibos Moschatus." The meat is described as tasting like very tough beef, with a flavour of musk, but this is said to be obviated by skinning the carcase, and removing the viscera as quickly as possible after it is killed, in which case the meat is obtained free from this disagreeable taste. But if these precautions are neglected it soon becomes uneatable. The dressed carcase of a good musk ox will sometimes weigh above 8 cwt, † and forms a welcome

* *Encycl. Brit.*, 9th Edition, Vol. xvii, p. 108. (Article "Musk Ox.")
† *Ibid.*, p. 108.

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addition to the larder of an arctic exploring party, when they are fortunate enough to obtain it.

It is curious that no trace of the musk ox has been found in Spitzbergen; its range seems to be confined, at present, to Arctic North America; but in days gone past, it was much more widely distributed, as is proved by the discovery of their fossil remains in Siberia, along with those of the Mammoth, and other extinct quadrupeds; their remains have also been found in the plains of Germany and France, and also among the Pleistocene gravels and clays of England, * showing that there was a time when the musk ox roamed over Europe as the domestic ox does now. And here again, the veil which enshrouds a period of vast antiquity is once more raised, and we are able to discern far in the mists of bygone ages an era when an arctic climate reigned in England—for it is probable that the musk ox browsed on an English landscape during a glacial epoch, when the climate of England probably resembled that of Labrador in the present day: and though this great ice age is gone, there still exist the marks of ice excoriation, to prove that it existed and that its glaciers once ground the ravines and summits of our Scotch and Irish hills; the musk ox, however, though long extinct in Britain, still survives amid the eternal snows of the frozen north, a living relic of that ancient world, proving that even in those dreary solitudes Nature has preserved certain forms of animal life whose economy is specially adapted to the frigid zone, and has transmitted them through long ages of geological time as a survival of the past.

* *Encycl. Brit.*, 9th Edition, Vol. xvii, p. 108.

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It thus seems probable that the musk ox represents one of the most ancient forms of life now existing among the mammalia of the modern world.

Remarkable also is the fact that the most noteworthy examples of these primeval types of animals seem to be preserved where the greatest extremes of climate exist: *viz.* in the hottest regions (Central Africa) and in the coldest (the Arctic Zone). If this be so, it is a wonderful example of that strange power sometimes exercised by Nature, of maintaining the existence of particular species under what would seem to be the most unfavourable possible conditions; whilst we have numerous instances of others which have flourished under circumstances where everything seemed to favour them, and yet they have dwindled and become extinct; of this latter, perhaps we might venture to quote the case of the disappearance of the horse (var., *Equus Curvidens* [Owen]) from the great plains of South America, as a good illustration: where this ancient horse has left nothing except its fossil bones to testify to the fact of its existence; then about 1537, when the Spaniards came to settle there, they brought with them and landed the Spanish barb on the banks of the Rio La Plata, which has since flourished so enormously that it has overspread the whole area of the region of the pampas with immense bands of tame and also of wild horses. So numerous have the barb horses become, that we have been, in our time, to places where a fairly good horse could be purchased for six dollars and even for less, while thousands of mares as we have elsewhere pointed out were annually slaughtered for the value of their hides and bones. Now the variety of

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the horse which perished was an animal which, as its name implies, was possessed of curved teeth. Was it to this circumstance that its extinction was due? We cannot positively say—but it may well be that an even smaller circumstance than this might suffice to turn the balance, and decide the fate of a race, under the imperious necessity of the great natural law, first insisted on by Darwin, of "a perpetual struggle for existence and the ultimate survival of the fittest."

It is not however alone in the case of one or two solitary instances of large animals, which contrive to maintain existence throughout the long night of the polar winter, that we encounter marvellous examples of vitality under (apparent) adversity, in the Arctic Zone. There are still the cases of the arctic hare, and mouse, the lemming, the marten, and the ptarmigan (besides others), upon each of which we propose to say a few words.

And here we would remark, that when we wonder at the seeming difficulties under which these creatures constantly live, it is yet probable that could we remove them to some more hospitable shore, it would prove but a cruel kindness, and that to them our officious meddling would simply mean destruction. Man is but too apt to judge of everything from his own standpoint of view; and to argue that because to *him* the great night of an arctic winter, and the drifting snow which covers everything, would be but a cold comfort, *ergo*, it must be so to everything else.—Nothing, however, as we know, can be further from the fact. To these seemingly weak and delicate denizens of the Polar Zone, the snow drift is a home which furnishes them with both house and covering: beneath its

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enveloping shield the nutritive lichens, and other plants upon which they browse, are protected (as by a glass house erected over them) from the rigour of the elements. Not only does it serve as a covering to preserve them from the influence of the great external frost, but it also shields the earth itself from its intensity, while the continual dripping of water from its under side at a temperature just above its freezing point, affords constant nourishment to the plants beneath, so that the moment spring arrives and a hot wind causes the liquefaction of the snow, they are instantly ready to start into vigorous growth—indeed it is doubtful whether some of these plants do not maintain a constant growth throughout the winter, even while buried beneath the snow. There are certain plants which as we know, continue to grow in darkness and while covered up from the atmosphere and sunlight, even in our own country; we need go no further to seek for examples, than the mushroom, the seakale, and the rhubarb, which grow in this way, when "forced" for early use, in all our wel lconducted gardens. In the same way, we believe that some at least of the arctic plants are constantly growing beneath the snow. We may cite the purple flowering saxifrage (*Saxifraga Oppositifolia*) as a probable instance in point, because wherever bits of it appear above the surface, even during the depth of winter, where the movement of the drifting snows may have temporarily exposed it, this wonderful plant always seems, though exposed to the full influence of the icy winds, to be covered with newly grown, tender green, shoots. *

* *Voyage to the Polar Sea*, by Capt. Sir George Nares, R.N., 1878, Vol. ii, p. 205.

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We shall even go a step further, and endeavour to show that it may actually be possible for plants to exist for ages in a state of profound coma, beneath glaciers, without perishing; and that as time rolls on, when a change of circumstances causes the glacier to retreat, their vegetative process is resumed. This resurrection of plant life (if it be a fact that it does take place) is a phenomenon so very wonderful that no words of ours are adequate to convey an idea of its truly marvellous nature: the fact however that perennial plants are now known to spring up immediately in the rear of the retreating ice, goes a long way to establish its authenticity. In the natural course of things, it would be annuals, and other plants whose seeds are known to be carried long distances by the wind, that might be expected to be the first to appear in this way, but the vegetation of glacier lands is so poor that this class of plants fails to distribute themselves in the usual way.

Professor Meehan has given his reasons for believing in these facts, for in a catalogue of plants, collected along the coast of Alaska in 1883, he states that they were not found merely to follow in the wake of glaciers, or to grow from material brought down by them in their advance; but that what he saw convinced him that they remained for an indefinite period in existence under the ice, retaining vitality, and pushing again into growth when the ice retreated, and he explains that he was led to this conclusion,

"from finding no annuals in the immediate wake of retreating glaciers in Alaska, where the number of perennials would be as great as if much time had been given for floral advance. These and other facts led to the hypothesis that these plants

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were not migratory, but had held their position through the whole icy period. While the finding of living willow trunks, grass, and perennial plants of many years growth, close to the edges of retreating glaciers, seems to place the point beyond any reasonable doubt." *

The length of time during which these growths may have remained in a state of suspended vitality, beneath the ice, is of course a matter which there are no means of determining. All that can be said on that head is, that so far as is known, glaciers retain their positions for long periods of time, without any considerable change. They are known to be *always moving*, but so slowly that their advance sometimes amounts to only a few feet in the course of a year.

Returning however to the questions respecting animal life in the polar regions, we find that all these small arctic animals, to which we have referred, are of the order "Rodentia" (except the marten, [*Mustela Erininea*] a creature which doubtless lives by preying upon the others); all of these therefore, presumably feed upon the leaves, bark and shoots of shrubs and plants, and all of them, the hare included, live in the snow drifts (where the arctic hare has holes like a rabbit), and there can be no doubt that they burrow down, and descend to the surface of the earth in order to reach these plants, which are, as we venture to believe, continually growing there.

It might perhaps be supposed that the act of always mining through heavy masses of snow would prove a work of endless labour, difficulty, and danger, to any creature that might attempt it. Observations upon

* See Article on *The Flora of Greenland*, in *The Athenæum* for June 24, 1893, p. 187.

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the condition of the polar snows, however, show that there are almost everywhere *caverns*, and *open spaces*, existing at the surface of the ground, underneath them. This is a very curious and remarkable circumstance, and one of high scientific interest, which at once (assuming its correctness) explains the facility with which these little arctic animals live and thrive, in the midst of a dreary waste of ice and snow, where apparently no living thing could long survive.

That these hollow spaces *do* unquestionably exist underneath the snow, is proved by the well-known fact that persons walking about upon its surface, as the summer draws on, frequently find large areas of the snow field subsiding beneath their feet into these caverns, showing that extensive hollows were there, and that the snow does not everywhere rest solidly upon the ground, but is merely supported upon columns of it, here and there. Sir George Nares for instance, mentions that

"in July 1876, while walking above an extensive surface of snow, it readily gave way and sank beneath us, with a muffled noise, not only immediately under our feet, but a large area of it acting in combination: how large we cannot say, as no crack is visible in the neighbourhood." *

The very considerable supporting power of snow roofs and arches, used in the construction of snow houses, is well known; spaces of considerable extent being able to be safely roofed in by hard snow, without the necessity of interior support. For instance we are informed by the same authority that in some houses, erected for the Polar Expedition of 1875-6—

* *Voyage to the Polar Sea*, by Capt. Sir George Nares, R.N., 1878, Vol. ii, p. 79.

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"the passage ways between the houses were roofed over with flat slabs of extremely hard snow, these are now binding with their own weight and that of the superincumbent snow; but the latter solidified sufficiently to form its own support; and we can now remove the original roof without danger." *

This as we conceive exactly describes the process by which the cavities forming at the ground level are supported, the decay of the snow there being of course effected by the drip of the slowly melting mass, which is always wasting over the whole extent of its under surface, while it is renewed as constantly by fresh falls upon its upper. It has been found that snow resting upon the ground invariably has a tendency to melt, the moisture quickly evaporating and becoming dispersed into space, or forming a coating of ice upon the snow roof above. Thus, while working in the snow houses of the expedition already referred to, Dr. Moss, surgeon on board the *Alert*, states that he observed that "any small quantity of snow left on the floor, evaporated; the moisture rising and collecting on the inside of the dome of the house, as rime;" † and there can be no doubt that the action going on upon the earth's surface, is of a similar nature.

But *why* should snow melt, when it touches the ground?—Is it because a certain amount of caloric is being constantly exhaled from the earth's surface, proceeding from the stores of internal heat, which we know exist within the terrestrial sphere? This is certainly the interpretation we are disposed to place upon this phenomenon. This melting of the snow however proceeds irregularly, certain places from a

* *Voyage to the Polar Sea*, by Capt. Sir George Nares, R.N., 1878, Vol. i, p. 221.

† *Ibid.*, Vol. i, p. 225.

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variety of causes decaying faster than others: in this way it is evident that considerable cavities must exist underneath, in which there can be no doubt, small animals can pass and repass without difficulty, and so are enabled to feed upon the plants which grow there as if under the roof of a house—and like rats and other subterranean living animals in our own country, these creatures thus exist in security, doubtless collecting nests of grass in crevices of rocks, and beneath the shelter of stones, etc., where they can rear their young, in what to them is a warm and comfortable abode, considerably warmer in fact, at all times, than the exterior atmosphere.

It is nevertheless a wonderful fact, when we come to think of it—and one worthy of all men's attention, as a striking example of the boundless resource and adaptive power of Nature—to find that, in these vast snow fields, where all appears to be a howling wilderness, destitute of any form of life, continually swept by the fury of icy gales and swirling clouds of driving snow, there should still be small and delicate animals, passing their lives in peaceful security beneath, unaffected by the greatest rigours of the tempest or the frost, ready when the long night of winter is over, and the summer returns, to issue once more rejoicing from their holes, to bask in the blessed sunshine, and people the country with myriads of harmless and beautiful living creatures. That they do reside in these regions throughout the winter, is proved beyond a doubt by their occasional appearance upon the surface on fine days, when their tracks are often clearly visible to arctic explorers; the animals themselves being also sometimes seen and shot.

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One of the commonest of these little creatures is the lemming (*Myodes Lemmus*) * an animal belonging to the order "Rodentia," about the size of a rat; of these there are probably several varieties, and one of these, the ringed lemming (*M. Torquatus*), is stated by Sir George Nares to be found in great abundance throughout the far northern regions, where it was traced to the extreme point attained by the expedition under his command. †

"We find their holes (he says) everywhere, apparently made for the purpose of ventilation, for they do not often appear on the surface at this season" (winter)—"they appear to be usually contented with the exercise they get in the hollow space under the snow, where the temperature is very little below zero, and their nests must be considerably warmer" § —and again—"The Lemmings are evidently feeding under the snow, for the few tracks do not point towards the patches of vegetation left uncovered." **

The enormous numbers in which these animals sometimes swarm, might appear to many people almost incredible. In Lapland, and in certain districts of Norway and Sweden, they sometimes assume the proportions of a regular plague; visiting districts of country where they are ordinarily quite unknown, at intervals of from 5 to 20, or more years; at which times the country is

"literally overrun by an army of these little creatures, which steadily and slowly advance, always in the same direction, and regardless of all obstacles, swimming rivers, and even lakes, several miles in breadth; and committing considerable

* *Encycl. Brit.*, 6th Edition, Vol. xiv, p. 436. (Art. "The Lemming").
† Lat. 83° 20′ 26″ N.
§ *Voyage to the Polar Sea*, by Capt. Sir Geo. Nares, R.N., 1878, Vol. i, p. 238.
** *Ibid.*, Vol. i, p. 241.

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devastation on their line of march, by the quantities of food they consume." *

On these occasions, true to their habits of living in the dark beneath the northern snows, they only travel by night; † and as is usual when any pest appears, they are followed everywhere by crowds of birds and beasts of prey, which reap a rich harvest of food from the ranks of the invading hordes, upon which they live. These swarms of lemmings generally disappear as suddenly as they came, and the Norwegians have a curious legend concerning their disappearance, which holds that, when they at length reach the coast, the entire company end their journey by committing wholesale suicide in the waters of the ocean; after which, they are of course seen no more. It is sufficient however for our purpose to note the fact that they *do*, in some way, suddenly disappear. Another remarkable instance of a small, weak creature, surviving amid the eternal snows, is that of the arctic mouse (*Mus Musculus*). These ferocious little creatures seem to swarm in summer pretty well all over the barren grounds of Arctic America; at that season the mice are brown, but like other polar animals, turn white in winter. As regards the ferocious nature of this mouse it is stated that "if disturbed in a tuft of grass, it will turn on a man, and dance, with impotent rage, at his feet." §

Mr. Pike says he has met with one of these mice crossing immense snow-covered lakes in winter time, miles from the shore, and no place seeming to be too

* *Encycl. Brit.*, 9th Edition, Vol. xiv, p. 436.

† *Ibid.*

§ *The Barren Grounds of Northern Canada*, by Warburton Pike, 1892, p. 183.

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cold, or too barren, to keep this little creature going; and he relates an amusing story about one of them, thus met with while they were travelling over the ice, and which the mirage, occasioned by fog, caused the party to mistake for a musk ox—a slight error, affording a good illustration of the difficulty there is in recognizing objects distorted by mirage and seen through these fogs.

"We saw an animal (he says), apparently at some distance, bounding along the horizon. All along the line there were cries of 'musk ox'—guns were snatched from the sleighs, and even the dogs charged at full gallop, in pursuit; but after a rush of ten yards, the object suddenly disappeared—a man had put his foot on it, and it turned out to be one of the small mice, so common in the barren grounds. What it was doing out on the lake, at this time of year, instead of lying comfortably curled up under ground, I cannot say." *

The arctic hare (*Lepus Glacialis*) is another example of a much larger animal, which undoubtedly passes the winter in the most northern regions, as yet visited by man.—Its tracks, and even the hare itself has been seen by explorers everywhere, but unfortunately not in sufficient numbers, to prove anything more than an occasional delicacy to hungry travellers. It is an animal, perfectly white in winter, fully as large as an English hare, which will at a pinch provide a meal for a small party. Partially white hares are now common in the London game dealers' shops, in spring time, were they may often be seen hanging in considerable numbers. This sub-arctic variety of the polar hare, as we have been informed, is mostly imported from Russia.

Sir George Nares found them inhabiting the most northern land yet visited, where they attained the

* *The Barren Grounds of Northern Canada*, by Warburton Pike, 1892, pp. 88, 89.

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weight of from 8 to 14 lbs. "These hares" (he says) "are pure white, with black tips to the ears, and under apparently very adverse circumstances, live in burrows or holes scraped horizontally into a snowdrift," where he thinks they mainly feed on "Saxifraga Oppositifolia," the hardy plant of which we have already spoken, as found growing all over the polar regions, which even where it was "opposed to the wind," bears "delicate green buds" that are nibbled off by the hares. * In a game list which is appended to Capt. Nares' 2nd volume it appears that 216 of these hares, 63 musk oxen, 8 foxes and one reindeer were killed by the members of this expedition. † There can be little or no doubt therefore, that the polar hare mainly lives beneath the snows, much as the lemming and other animals do, during the winter season; because on some days the members of the expedition were occasionally able to secure 3 or 4 of them; and then again perhaps for a long time there were no more of them to be seen. During the dreary solitude and tedium of the long polar night, these sporting adventures often prove a valuable source of interest to imprisoned explorers.—And in addition to hares, birds can also occasionally be shot; of these the rock ptarmigan (*Lagopus Rupestris*) is by far the most common. Its range, in all probability, extends to the pole, and certainly goes beyond the furthest point yet reached by man, close to which tracks of ptarmigan were clearly visible in the snow, as well as at intervals all the way up to it. The

* *Voyage to the Polar Sea*, by Capt. Sir Geo. Nares, R.N., Vol. ii, 1878, pp. 204, 205.

† *Ibid.* Appendix to Vol. ii, pp. 352, 353.

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tracks of these birds are generally seen in conjunction whith those of hares, and it seems probable that they exist in much the same way as their fourfooted companions, and live like them beneath the snow, and feed upon the same plants. Although only 52 seem to have been killed by the late Arctic Expedition under Sir G. Nares, * ptarmigan are nevertheless known to thrive everywhere in the polar regions, and also on most mountain ranges throughout the northern temperate zone, which are pretty constantly covered with snow. Thus in Scotland it is stated on good authority that these hardy birds "are seldom found in any quantity below 2000 feet; and where the heather and grouse cease to exist, there they thrive." †

Ptarmigan are consequently known as the "snow-grouse," and the red grouse of Scotland (*Lagopus Scoticus*, which belongs to the same family as the "heather grouse)."

But although no degree of cold appears to be too intense for ptarmigan, it certainly seems strange how they manage to support life during the depth of the polar winter, when everything is so deeply buried beneath the snow. It would seem however, that to these birds the drifting snows provide at once a shelter and a home: it is to their cover that they will at once fly, when alarmed, or when seeking refuge from the force of the icy blizzards, which so frequently sweep the surface of vast expanses of the arctic snow fields in winter; and during severe weather they seem seldom

* *Voyage to the Polar Sea*, by Capt. Sir Geo. Nares, R.N., Vol. ii, 1878. See Appendix, and Game List, pp. 352, 353.

† *Shooting and Salmon Fishing Hints and Recollections*, by Augustus Grimble, 1842, p. 107.

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to quit the shelter of the snow, where they have regular holes, like the hares, which they constantly inhabit, only emerging from them in fine, still, weather. It would therefore seem that in some way they must manage to work their way through the drift until they reach the vegetation, which as we have explained is probably always growing in the hollow chambers which unquestionably exist at the surface of the ground beneath—and it may be that they construct these burrows while the snow is still in a soft state, in autumn, and that their breath congealing upon the inner surface is sufficient to prevent their collapse and even to enlarge them, until the snow has hardened and afterwards melts away in spring.

The fearless way in which ptarmigan, in common with other varieties of northern grouse, will fly headlong at full speed into a snow drift, has often been noticed and commented upon by travellers with astonishment. On striking the drift they of course instantly disappear, knocking up a little cloud of snow-dust by their impact, as if it had been struck by a bullet.—Mr. Lloyd, in his "Northern Field Sports," has noticed the same peculiarity both in the blackcock and the capercailzie, in Scandinavia; and Mr. Levinge has observed it in the case of the "Birch Partridge" as it is called, in Canada. This bird is however a true grouse (*Tetrao Umbellus*) and Mr. Levinge says—

"When about to ensconce themselves, they charge into the snow with all their might, the impetus carrying them some way into it, sufficiently far to prevent foxes etc. being attracted to the spot: indeed so small is the orifice in the snow, the particles of which naturally fall over it, that the unpractised eye might pass numbers of these birds, thus concealed. The

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initiated however detect a sea-green spot of reflected light in the disturbed snow, and numbers of these birds become an easy prey to the Indians, who when the snow is so soft that the birds can hide in it, need never go supperless to bed." *

At this season in fact the Indians often catch them thus with their hands, in the midst of apparently barren snow fields, where to all appearance not a living thing exists.

In a recently published book upon Russia, a graphic account is given of an English sportsman who suddenly came upon a regular colony of blackcock, which were thus hid in the snow, while he was travelling through the forest, at a time when the snow was deep; when a number of these birds suddenly rose one after another all round him.

"To my intense surprise (he says) another blackcock rose at my very feet, and flew off; another and another rose within a few yards of me. Blackcock rose from any quarter, right and left, in front and behind, without the slightest warning. One, out of the snow at my very feet, covering my snow shoes with a shower of white spray, as it rose, apparently from the bowels of the earth. Will it be believed that as I stood in one spot, at least thirty blackcocks rose within easy shot, one by one? In five minutes they had all gone, and I was at liberty to examine the holes. I found each was a long narrow passage, from a yard to a couple of yards in length. I afterwards heard that the blackcock in rough weather, when the snow is deep and soft, desert the trees and bushes, and flying in a body, suddenly with one consent, swoop downwards with folded wings, but at full speed, and take a 'header' into the snow—each bird thus penetrating to

* *Echoes from the Backwoods of Canada*; Experiences of an Old Settler, by Capt. R. G. A. Levinge, 1849, Vol. i, pp. 126, 127.

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the distance of a yard or two, and forming a comfortable warm lodging for the night. *

It might appear at first sight that such a manœuvre must be attended with great risk of injury to the birds; as for instance, if they should happen to strike against a branch, or other hard object buried beneath the snow; but the great depth of the drifts, and the exceedingly fine, dry, powdery nature of the snow, seems to render it as safe for them to dive into, as the water is for a gannet, fishing in the sea. We know that the gannet will suddenly plunge into the water with great force from a very considerable height, but experience shows that whether it be into water or into snow, in neither case do the birds seem to ruffle as much as a feather, while executing these bold feats with that perfect confidence which is born of a knowledge that they may perform them with impunity—and in performing them, the birds, no doubt, instinctively close their wings and feathers, so that they plunge into the opposing element, which then merely serves to press or smooth the feathers closer to the body, without doing the slightest injury to them.

The question of the white, or protective colours of arctic birds and animals, of which the ptarmigan is a conspicuous example, is a matter which deserves a brief notice. There are some glass cases in the South Kensington Museum, containing groups of these birds, and small animals, which illustrate very beautifully this phenomenon of protective colouring, both in the desert and in the arctic zones. The instances of this pro-

* *Out of Doors in Tsarland, a Record of Wanderings in Russia*, by Fredk. J. Wishaw, 1893, pp. 115—117.

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tective colouring collected by Mr. F. S. Worthington, in 1890, from the Egyptian deserts are all *sand coloured*, to match the colouring of the surrounding landscape—while the white birds, and small rodents, illustrative of the same subject in the arctic zone, were presented by Professor Collett, of the Zoological Museum at Christiania, in 1891.—Only in three instances, we are informed by the descriptive cards attached to these cases, is the white colour retained throughout the year—namely in those of the snowy owl (*Strix Nyctea* [Linn.]), the Greenland falcon (*Falco Candicans* [Linn.]) and the polar bear (*Ursus Maritimus*). The summer livery of all the others conforms to the hue of their surroundings at that season, and the white dress is assumed only during winter. Among the latter the ptarmigan in spring is found to have its plumage mottled with brown spots and bars.—This is usually regarded as an effort of Nature to preserve them from the attacks of enemies; and it must be manifest that snow-white birds among brown rocks and gravels would be very conspicuous objects in summer time; the very great value of the protection afforded by the brown dress thus at once becomes apparent: but if it prevailed in winter time it would then be disastrous. The prevalence during winter time of white in the colourings of ptarmigan and other arctic creatures, is therefore to be regarded as the result of a positive natural law, "the ultimate survival of the fittest," which Mr. Darwin first brought into prominent notice. It is evident that brown birds or animals would as we have observed become such conspicuous objects on the surface of a snow field, that they would certainly stand much less chance of

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survival in the battle of life than their white-robed companions—the latter would therefore in the end assert their superior fitness, and would thus survive, whilst the former perished—of this there can be little doubt; but that does not explain to us by what process Nature proceeds to whiten the fur and feathers of her proteges. The question therefore which we propose to ask ourselves is—How do they come to turn white? Are we to regard this as merely an effect of exposure to great cold? And if so, does it ever whiten the coats of birds and animals exposed to exceptional cold, which are always (except on those rare occasions) otherwise coloured?—We can have no doubt but that these questions must be answered in the affirmative.

We humbly venture to believe, and say, that in our opinion the white colours of the creatures inhabiting the polar regions are simply due to the permanence and intensity of the cold. This however is a highly technical question, and we feel that we are here treading upon somewhat delicate ground, concerning which conflicting opinions may be held, and that it is sometimes said that in the case of birds, these changes of colour are due to a regular moult, and *not* to any change of colour in the feathers themselves; we are inclined however to regard this view as an error.* Alteration in the colour of the hair, in the case of the human subject for instance (where the matter has been made the subject of extensive research) is now known to proceed from "the arrest of pigmentation, which gives rise to

* See for instance observations on this subject in *A Spring and Summer in Lapland*, by Horace W. Wheelwright (Naturalist), 1871, pp. 314—317.

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greyness at every period of life, and to the hoariness of old age.",*

Let us consider therefore for a moment this question of change of colour in the human hair. Each hair is embedded in a depression of the skin, called a "hair follicle," and the root of the hair dilates, at its lower end, into a bulb, † as any one can see, by pulling a single hair out of his head. Now, as we conceive, the effect of great cold upon the skin of arctic birds and animals is to cause contraction in the roots of the hair, or the tissues from whence the feathers draw their nourishment, so as to create either a complete arrest of pigmentation, or else a modification in the pigment, so that they become more or less completely blanched. Feathers in all probability follow the same rules as hair. That cold has the effect of causing changes of colour in this respect has been noticed and admitted by Darwin; but unfortunately he did not proceed to explain in what way he believed these changes to arise—but that exposure to cold is of itself sufficient to turn animals white, is to our mind clearly proved by the case of hares in Ireland during the exceptionally severe winter of 1878—1879. Upon that occasion we happened to be there, at a place where there were then (before the era of Mr. Gladstone's Land Acts) many hares; all of which turned more or less white, and some of them became completely snow-coloured all over, a thing that had never occurred there before within the memory of any living man. § Yet

* *Medical Dictionary*, by Richard Quain, M.D., 1883, Vol. i, p. 576. (Art. "The Hair").

† See *Encycl. Brit.* Vol. i. (Article "Anatomy"), p. 898.

§ Personal observations and notes made by the Author, at Hilton Park and other places in Ireland.

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when the great cold passed away and spring returned. these animals gradually resumed their normal yellowish colour, and white hares disappeared. In the London game dealers' shops in spring, many Russian hares are as we have mentioned exposed for sale, partly, or even entirely, of a white colour; but on enquiry into this matter when in Russia, we were given to understand that hares always turned more or less white there every winter, and changed colour again in spring. The case of the hares in Ireland in 1878, which was there regarded as unparalleled, is therefore an event of annual occurrence in Russia, and also we believe in Norway and Sweden.—Then as regards birds, the ptarmigan, of which we have been speaking, is known in Scotland to be mostly of a brown colour, like ordinary heather grouse, in summer, but to assume its snowy garb on the approach of winter. These considerations, as we believe, fully justify us in regarding the universally white colours seen among arctic birds and animals as due entirely to the rigour of the climate, and that it is by this means that Nature effects these changes; though we do not deny that the interbreeding of animals, etc., of this colour, during long periods of time, may also have had its effects in rendering the white colour more pronounced and snow like; and possibly if some of these creatures would bear transportation to a southern climate, it might be found that this colour had become permanent in the case of some of them: a white bear cub for instance, brought to a zoological garden, always remains, *not white*, but yellowish-white.

The effects of great cold are so peculiar and remarkable that to those who have never experienced any-

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thing of the kind it is not easy to convey an adequate idea of it. Strange to say, contrary to all that might be expected, it bears a close resemblance, in many of its leading conditions, to those produced by great heat. Woodwork and all articles of horn, bone, or ivory will shrink and crack for instance, during an arctic winter, * exactly as when exposed to a hot sun or to intense dry heat, and the fittings of cabins, etc., on board ships, will open and warp, quite as much as, or even more than, during a voyage to the tropics. Beams and other heavy scantlings of timber will also frequently suddenly crack, with a loud report, resembling a rifle shot, especially if in a green state, as for instance in the case of logs used in the construction of houses. Even growing trees will often be heard to crack (or explode) in a similar manner, during the prevalence of intense frost, such as occurs periodically in the forests of Canada, and in other localities with an extreme range of temperature. These facts are so well known to all travellers and settlers in North America, that it seems hardly necessary to do more than state them. Mr. Rowan for example in his well-known book, written for emigrants and sportsmen in Canada, when giving a description of a hunter's winter camp in the forest, says: "Suddenly a loud sharp report, close by, wakes him. What is it? A rifle shot?—No —simply a tree, cracking with the frost." These noises he thinks "are not caused by the freezing of the sap, for" (he adds) "I have heard the same cracks in dry seasoned timber, in the wall of a house." †

* See Sir John Richardson's *Boat Voyage through Rupert's Land*, 1851, Vol. ii, p. 101.

† *The Emigrant and Sportsman in Canada*—Experiences of an Old Settler, by John J. Rowan, 1876, p. 294.

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So again, Captain Anderson, of the Royal Engineers, while employed on surveys connected with the North American Boundary Commission, at the Lake of the Woods, in Manitoba, thus states his experiences, while sojourning there in a winter camp:

"There were occasional days and nights of clear weather and motionless atmosphere; on these occasions the thermometer would show the greatest degree of cold, and in the woods an audible evidence of its intensity was occasioned by the freezing of the sap in the trunks and branches of the trees, and the consequent bursting of the bark, with a report like pistol shots. This chorus would sometimes continue throughout the night, and the frequency and violence of the reports would afford a good comparative measure of the cold." *

It will be observed that these authorities differ upon the probable cause of this phenomenon, which may arise from several causes, so that in the case of growing trees it may be that Captain Anderson's is the correct one; whereas in perfectly dry timber, it is probably simply due to the shrinking of the wood—loud cracks in floors, as we know, are common in newly erected houses; and in great cold, such as we are now considering, there can be no doubt that the frost increases the rigidity of the fibres of the timber, so that when at length they do give way, they do so with commensurate violence, accompanied with very loud reports. But it is not wood alone, but all articles of horn, bone, etc., also warp and fall to pieces just as in very hot weather.

The advent of the winter cold, we need hardly say,

* Capt. S. Anderson, R.E., on the North American Boundary Commission, in Vol. xlvi of the *Journal of the Royal Geographical Society* for 1876, pp. 235, 236.

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is as a rule followed everywhere throughout the temperate zones by the decline and fall of the leaf of deciduous trees, and by the arrest of vegetable growths; thus producing an interval of rest for plants, which is almost as essential for their well-being as it is for men and animals; it is not however so generally known that this period of rest is as efficiently created by heat as by cold. In tropical and sub-tropical lands for example, where there is a long dry season, we have already shown that combined heat and drought will cause the fall of the leaf from trees and plants, exactly as the cold does in northern regions, and they subsequently remain bare of foliage until the return of the rains again starts them into growth; the advent of the rains therefore represents our spring in these countries. Even in the equatorial zone an artificial period of rest can be produced for trees imported from temperate regions, by exposing the roots to the fierce heat of the sun during short intervals of dry weather.

In our section on the Equatorial Zone this matter has been gone into at greater length, and further details about it will be found there.

The highly charged electrical condition of the atmosphere in the arctic regions, though thunderstorms are rarely or never seen there, in many respects also bears a close resemblance to the results following upon the intense dry heat of the desert zone; in both cases the dryness of the atmosphere is very remarkable, and in each, the phenomena of sparks emitted by woollen garments, etc., is reproduced. * Thus during

* See *Seas and Skies in Many Latitudes*, by the Hon. Ralph Abercromby, F.R.M.S., 1888, p. 8, and Sir John Richardson's *Boat Voyage through Rupert's Land*, 1851, Vol. ii, p. 101.

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severe dry cold, blankets and other woollen clothes adhere to each other, and if roughly drawn apart will frequently be found to emit sparks, accompanied by a crackling noise, while in a dark room quite a brilliant glow of light is at times thus created. Even passing a comb through the hair or beard is, on these occasions, sometimes sufficient to draw forth distinct electric sparks. These curious phenomena may be produced, as we have said, by either intense dry cold or heat, and the effects in both cases seem to be almost identical.

Then again there is the well-known fact, that in very low temperatures a piece of metal, applied to the skin, will adhere to it, and produce a *burn*, exactly as if the iron had been red hot; if however both the iron and the hand be perfectly free from any trace of moisture, no actual "burn" will ensue, but merely a severe stinging sensation, like that produced by contact with a galvanic battery; the slightest moisture is however sufficient to make the skin stick to the iron, and a painful blister is at once formed, precisely as if by a burn from a heated iron.

Then proceeding another step in advance, we are again met with the curious similarity which exists between the effects of *burns* and *frost-bite:* we do not here refer to slight cases of frost-bite, but to the more serious cases, which in many of the symptoms closely resemble those of severe burns. There is the same extensive blistering, destruction of the cuticle, fever, swelling, and acute inflammation of the surrounding parts. If the frost has entered far into the flesh (as for instance in cases of the congelation of a limb),

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there is the same complete destruction of the deeper tissues, sloughing, and ulceration; and the same subsequent difficulty of healing, and tendency to gangrene. Each and all of these symptoms follow every severe case, either of burning or of frost-bite.

As in the case of burns, frost-bites may of course be of almost all degrees of intensity, and slight cases merely extend to a deadness or numbness of the part, and are easily recognised by the place turning white. The person is at the outset usually ignorant of what has occurred, as there is no pain. The first effect of frost-bite is loss of sensation; as long as sensation continues the part is safe. When first bitten however, if the thing is observed by a comrade and taken in time, no very great harm is done, though return of the circulation is usually accompanied by a severe smarting or burning sensation, and the part remains red and swollen for some time: it is also rendered more liable to be again bitten than a sound part. It is commonly supposed that the thing to do is, immediately on the discovery of a frost-bite, to rub the part violently with snow: nothing however can be more unwise, or even dangerous; if the part is at all badly frozen, in the case of fingers, toes, etc., it may detach the flesh from the bone, and cause serious injury; it must be always remembered that frozen flesh will *break*, if roughly handled, like a candle or piece of wax—its elasticity having been destroyed by freezing. Even a woollen shirt for example, which has been wetted, and then rigidly frozen, may be broken, if roughly or violently bent.* If snow is used therefore, the

* Sir J. Richardson, *Boat Voyage through Rupert's Land*, 1851, Vol. ii, p. 100.

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friction should be of the gentlest nature; but if it can be obtained probably the safest thing is the very coldest water, in which the hand or foot may be immersed, and the temperature of it slowly raised, to 50° or 60° Fahr., and the circulation thus very gradually restored. The return of sensation is accompanied by considerable pain in the part, and if the pain be very violent, it is generally to be regarded as a sign that warmth is being too rapidly applied. Sir George Nares expresses himself altogether against the use of snow, which in the far north he considers far too cold for the purpose, and for superficial frost-bites he advises very gentle friction by the hand to the affected part, as any rough handling would certainly remove the skin. * Probably the mere application of the warm hand for a time, without rubbing, would prove as efficacious, and safer.

Speaking of cases of frost-bite the Hon. Ralph Abercromby says:

"In extreme cases, when the flesh is thawed, it swells enormously, and rises in huge horrible-looking blisters, and gives intense pain. If the bitten part turns black in a day or two, it is all over with it, and nothing but amputation remains. Fever often supervenes at this stage; and during the Napoleonic wars at the commencement of this century the French lost thousands of men in Germany from 'fièvre de congélation.'" †

Congelation, we may observe, is the freezing of a limb, as contra-distinguished from superficial frost-bite of the external surface.

Severe cases of frost-bites or congelation, as we

* *Narrative of a Voyage to the Polar Sea*, by Captain Sir George S. Nares, R.N., 1878, Vol. i, p. 264.

† *Seas and Skies in Many Latitudes*, by the Hon. Ralph Abercromby, 1888, pp. 7, 8.

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have elsewhere pointed out are very common during hard winters, and in blizzards, all over the great plains of North America. During the severe winter of 1872 and '73, for instance, over 200 men in the vicinity of Fort Dodge are reported to have lost hands or feet, or part of them, and in one instance a poor fellow lost both hands and both feet.* In these cases of congelation no doubt gangrene had set in, necessitating amputation of the parts, for Colonel Dodge mentions that at least seventy operations were performed by the post surgeon on persons suffering from the results of frost-bite. The sufferings following cases of severe frost-bite, as related to us by persons who have undergone them, almost exceed belief. The numbers of persons frozen to death on the American prairies is also considerable, and "in the Russian Empire" it is calculated that "on an average 694 deaths occur annually from this cause;" † and extraordinary, but not the less true, is it to say that even to the very last in these cases, the analogy between the apparent effects of great heat and great cold does not cease. And though we have referred to this view of the case before, it can do no harm to briefly advert to it again here. Mr. Abercromby, with reference to this matter, remarks that before death by congelation "the singular delusion of oppressive heat supervenes," and "under the influence of this fancy the victim begins to strip off his clothes, and so hastens the fatal end." §

* *The Hunting Grounds of the Great West*, by Colonel Richd J. Dodge, U.S.A., 1877, p. 39.

† *Medical Dictionary*, by Richd. Quain, Vol. i, p. 271.

§ *Seas and Skies in Many Latitudes*, by the Hon. Ralph Abercromby, F.R.M.S., 1888, p. 7.

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There is a technical point of high importance which it is always desirable to bear in mind, in connection with this strange and remarkable occurrence—namely that the first effects of exposure, or of the application of cold to the human body, is to cause a progressive rise in the temperature of the internal organs. It has long been known that cold causes immediate contraction of the skin, and of the adjacent blood vessels, while heat on the other hand, dilates them. This contraction is sometimes so considerable, that its effects produce what is known as goose skin, or a rough papular appearance, somewhat resembling a goose's skin when the feathers are removed; while the blood, thus necessarily repelled from the external surface of the body, is thrown back upon the internal organs, producing a species of congestion: a condition which accompanies more or less, every ordinary cold, or catarrh, and hence the serious, and often even fatal complications which follow a neglected "case of common cold" when congestion of the lungs, or pneumonia, for example arises.

The late Dr. A. H. Garrod, a most rising and scientific young man, whose career was unfortunately cut short by an early death, made a regular series of experiments upon himself, with a view to determine the extent of the increase thus produced on the temperature of the human frame. It would be too long to state the results except in general terms.

"On stripping the human body (he says) in air of about 50° Fahr., a rise in the internal temperature commences immediately. This phenomenon (he proceeds to point out) is explained thus. The contact of cold air produces so considerable a contraction of the vessels, that the blood is so

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far driven inwards, that the conducting power of the skin is rendered considerably less: consequently, the body temperature rises, until a higher equilibrium is attained." *

The results of Dr. Garrod's experiments are given in tabular form, in his collected papers which we have here quoted from, and he has clearly shown that this increase of internal temperature is an undoubted fact, which would seem to afford some clue to the sensation of oppressive heat, which sometimes seems to haunt the last moments of those who have been frozen to death, and may thus cause them to remove their clothing.

More than that, as we know, persons when overcome by cold, often experience an overpowering tendency *to sleep*. This feeling of a desire to sleep is a species of coma, which under conditions of great cold, quickly passes into profound insensibility. It is a very common concomitant of many forms of death, where life passes from the sleep of time into that of eternity by so gradual a process that there can really be no doubt that the dying person passes away entirely unconscious of the approaching change. Now under exposure to great cold this seems to follow sleep, if indulged in, almost as a matter of course. We therefore venture to suggest that it may be, that the well-known deadening sense of great cold upon the mental faculties, predisposes these persons to the idea that they are merely retiring to bed to take their nightly rest, and so induces them to partly or wholly undress.

Those who have been exposed to the intensely cold winds of icy blizzards can quite feel that the chill is penetrating the nervous centre, so as "to make them

* *The Collected Scientific Papers of the late Dr. A. H. Garrod.* Edited by Wm. Alex. Forbes, 1881, pp. 37—41.

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feel quite foolish": we have many times known people exposed to great cold to express themselves in these very terms.

As a rule we think we may safely say, that serious cases of congelation are generally the result of some neglect or imprudence, and strange to say, they seem to be far more common upon the steppes and prairies than they are in the arctic regions; many of them we fear are the results of drink: in other cases of course, the victim has probably been suddenly overtaken upon the high plains by a blizzard, without being prepared for it, and in such cases people may often be literally frozen to death within a very short distance of their own homes. Sailors belonging to whaling ships also, are sometimes upset into the water, during the arctic summer, when the sea is very little above its freezing point, and on being taken out, the air being much colder than the water, become quickly coated with ice, and frozen. Respecting this latter accident Dr. Laing, surgeon on board the ship of the celebrated arctic navigator Captain Scoresby, makes the following observations:

"It is almost needless to remark (he says) that in this inclement region, swimming is of little or no use to any person who may chance to fall overboard, as his muscular motion is almost instantaneously obstructed by cold." *

This we may observe is almost always the case in very cold water. Unless the person gets out almost immediately, he soon becomes benumbed and perishes. In this instance a sailor had been upset out of a boat by a whale, and had been brought on board covered

* *A Voyage to Spitzbergen*, by John Laing, surgeon; 2nd Edition, 181[illegible], pp. 113, 114.

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with ice, and in an almost inanimate condition; from this state however, Dr. Laing says, he soon quite recovered, on the application of warmth and the administration of cordials. The object of mentioning the case is to show the rapid way in which the system becomes paralyzed, when brought into contact with great cold, as for example by immersion in the sea. In very cold water the strongest man lasts but a very short time, as we have said; yet on the other hand, dry cold, in a perfectly still atmosphere, is seldom dangerous, or even seriously inconvenient, provided that men are thoroughly well equipped against it. Dr. Moss, of H.M.S. *Alert*, for instance, says that:

"It was possible to walk for two or three hours over snow-clad hills, in a temperature 100 degrees below zero, without getting frost-bite—only the face and lungs are really exposed, and neither appear to suffer from it; and our experience (he says) led us to think that men thoroughly prepared might safely encounter far lower temperatures." "Many a time (he proceeds to remark) the relative merits of arctic cold and tropical heat were warmly discussed. Several of both our officers and men had lately returned from the Ashantee campaign, and they could speak with authority. There was one thing clear—one could sometimes get warm in the arctic, but never get cool on the (African) coast." *

Mr. Clements Markham also thinks that on the whole, these high latitudes are among the healthiest regions in the world.

"I will quote (he says) the evidence of one of the most distinguished medical officers who has served in the arctic regions, to prove that of all the seas visited by men of war, the arctic have proved the most healthy.

* *The Shores of the Polar Sea*, illustrated folio, by Dr. Edward L. Moss, M.D., 1878, p. 47.

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The mortality will be seen to be 1.7 per cent only;" * and again, "It is a circumstance worthy of note, that those who suffered from bronchial affections each winter in England, were exempted from them while in these regions." †

The cause of this immunity from chest affections, which has been so often noted by arctic explorers, is no doubt due to the exceeding *dryness* of the atmosphere. The therapeutic value of dry cold, in the treatment of certain forms of lung affections, is a matter which has been gradually becoming more recognised of late years, and delicate persons are now sometimes advised to try the effects of a winter residence in the Upper Engadine, in Switzerland, where on account of its great elevation (6000 feet over sea level) a regular arctic climate prevails for some months every year. Dr. Tucker Wise, resident physician at Maloja, states that during a recent season,

"Ordinary catarrh is almost unknown, except in badly ventilated houses, where a cold in the head, or sore throat, seems liable to be communicated to others. During the whole winter at Maloja (he says) no person suffered from the former complaint, and but two cases of sore throat occurred, through indiscreet exposure." "It is by no means uncommon (Dr. Tucker Wise goes on to say) for individuals to quit a room, and proceed out of doors, with a difference of 50°, and occasionally 60° Fahr., without feeling any pressing need of gloves or extra clothing." §

These are day temperatures; but of course at night the differences are considerably greater; also on these occasions an absolutely still atmosphere always exists,

* *The Threshold of the Unknown Regions*, by Clements R. Markham, F.R.S., 1878, p. 272.

† *Ibid.*, p. 276.

§ *Alpine Winter in its Medical Aspects*, by A. Tucker Wise, M.D., 3rd Edition, p. 98.

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as the least breath of air would make such a cold almost unbearable. Baron Nordenskiold, the well-known Swedish explorer, for example, tells us:

"In calm weather a cold of—40° F. is scarcely very troublesome; but with only a slight draught, and a cold of—35° it is actually dangerous to expose uncovered parts of the face, hands, or wrists, to the cold current, as without one's being warned by any severe pains, frost-bite arises." *

"Experience (Sir George Nares remarks) teaches us in these regions never to run during severe weather, for although the weather may be perfectly calm, the fast journeying through the air, at a temperature below minus 50°, has the same effect as if a light breeze were blowing." †

On one occasion with a temperature of about minus 48°, on a calm day, a party from the *Alert* happened to be out when a slight air began to blow for about ten minutes, and Sir George Nares says of it: "With so low a temperature, the sensation of stinging cold in the exposed part of our faces, was intensely painful." §

These facts are sufficient to show the great risks which are incurred in facing a wind while a very low temperature prevails, and explain how it is that we so often hear of people being actually frozen to death in blizzards, close to their own homes. In Canada, during severe winters, in the same way little inconvenience is felt by anyone in a still atmosphere, no matter what the amount of cold may be; and this season is often the merriest and gayest of the whole year, people all going about in sledging parties, and to other forms

* *Voyage of the Vega*, by A. E. Nordenskiold, translated by Alexander Leslie, 1881, p. 474.

† *Narrative of a Voyage to the Polar Sea*, by Captain Sir Geo. S. Nares, R.N., 1878, Vol. i, p. 249.

§ *Ibid.*, Vol. i., p. 239.

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of winter sports; but the moment that there is a *breeze*, the cold becomes intolerable, and everybody who is not compelled to go out of the house on urgent business remains closely shut up indoors.

Thus Colonel Warburton (who has written some of the best books extant on Canada), mentions that,

"One Sunday, when the thermometer was at 30° below zero, and a high wind was blowing, the effect in many respects was not unlike that of intense *heat*"—"for as the icy wind touched the face, it scorched it like a blaze. *

Here again, it will be observed, we recognise one of these strange similarities between great cold and great heat to which we have so frequently drawn attention, and anybody who has himself experienced the effects of one of these icy winds, will doubtless at once call to mind this curious sensation which Colonel Warburton here records.

The great colds of the arctic winter, it is well to observe, do not occur, as one might have supposed, during the great night of winter, but rather at its close, when the sun is beginning to reappear again. The increase of the cold appears however to be generally progressive throughout the winter darkness, as it also seems to be during the lesser nights in temperate regions; that is to say, the usual course of things is, as soon as the sun sets, a steady fall in the temperature begins, which, if no abnormal conditions set in to interrupt it (such for instance as a sudden change of wind), continues throughout the night, until sunrise, so that the last hours of the night are always the coldest;—the coldest hour of the twenty-four gener-

* "*Hochelaga*" *or England in the New World*, by Col. George Warburton, 1854, p. 59.

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ally being that which immediately precedes and accompanies the dawn. Experienced travellers who have seen much of camp life have but too good cause to know this. So also, it would seem, does the temperature progressively fall throughout the great night of the arctic winter. Dr. Moss, of H.M.S. *Alert*, for instance, says—

"As the absence of the sun lengthened, so the cold increased. Arctic expeditions have almost invariably registered their lowest temperatures in February and March, the months in which the earth is coldest, even in England. It may be said to be always freezing in the far north. The temperature sank permanently below freezing point in the middle of August, and continued below it for nine months. On the third of March, three days after sunrise, the unparalleled temperature of minus 73°.7 below zero was indicated by our thermometers, and for many hours the temperature remained more than 100 degrees below freezing." *

Captain Markham also comments upon this remarkable circumstance and says, "strange to say, our extreme cold came with the returning sun;" and alluding to this intense cold of 106° below freezing point, he states that it "was the lowest temperature recorded by the expedition, obtained from the mean of several thermometers; and so far as we could ascertain, the lowest really authentic corrected observation that has ever been registered." † During the latter part of February 1876 the temperature at the winter quarters of the *Alert* had gradually been getting lower and lower, until at length it fell to this unprecedented point; yet we are told it was as far back as January

* *The Shores of the Polar Sea*, by Dr. Edward L. Moss, M.D., illustrated folio, 1878, p. 46.

† *The Great Frozen Sea*, by Capt. A. H. Markham, R.N., 1880, p. 223.

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the 12th that the sky at noon, close to the southern horizon, first "displayed a decided tint of *green*" * although it was not till the 29th of February that they "saw the upper limb of the sun returning to awaken Nature from its long repose," † and it was only on the "4th of March, at 11.30 a.m., that the sun was clearly seen above the southern hills" § after an absence of 138 days, or say four and a half months. ** A number of curious circumstances which accompanied the above intense cold are related by Capt. Markham as the result of experiments tried by exposing various substances to its influence.

"Glycerine, upon which a temperature of—50° had little effect, became at —70° perfectly solid and quite transparent. Rectified spirits of wine became of the consistency of hair oil. Concentrated rum 40 degrees overproof, froze hard when exposed in a shallow vessel, like a saucer, but in large quantities it resembled honey, or molasses; whisky froze hard, and bits of it were actually broken off and eaten. Chloroform was the only substance, on which the low temperature had no apparent effect." ††

It is therefore evident that in future it will be prudent always to take highly concentrated spirits for the use of ships proceeding to these northern regions. This freezing constitutes a serious difficulty in the storage of liquids which are apt to get lost by the bursting of bottles, and the leakage of casks, in consequence of their expansion under the influence of frost; as soon as

* See *Narrative of a Voyage to the Polar Sea*, by Capt. Sir George Nares, 1878, Vol. i., p. 220.

† *Ibid.*, Vol. i., p. 249. § *Ibid.*, Vol. i., p. 263.

** At the winter quarters of H.M.S. *Alert*, in Lat. 82° 27′ N., Long. 61° 18′ W., the sun sank October 14, 1875 and rose March 4, 1876.

†† *The Great Frozen Sea*, by Captain A. H. Markham, R.N., 1880, pp. 223, 224.

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the temperature rises high enough for them to turn liquid again, they of course then run out and are wasted. Other articles, like lime juice, for instance, which is so necessary as a preventative of scurvy, become solid masses of hard ice, so difficult to thaw that their use on boat and sledging journeys becomes impossible, as sufficient fuel for melting them cannot be carried. These are only a few among the many difficulties encountered by arctic travellers. On the other hand in the far north meat will keep all the year round; and it is also said that salt beef and pork, if taken out of the barrel and hung in snow houses, gradually parts with most of its salt, and becomes much improved in quality—strong brine seems to resist the action of frost for a long time, and to have a tendency to concentrate itself under the influence of severe cold: the watery particles freezing, and the saturated solution of salt oozing away in liquid form.

The turning of the salt ice into fresh water ice, is believed to be also due to this cause. As to the fact of its doing so, there can be little or no doubt. The experience of Dr. Rae, during his long and laborious sledging journeys in the arctic regions, seems to be conclusive on this point.

"We were never (he says) able to find ice '*in situ*' (*i.e.* floating on the sea) either eatable when solid, or drinkable when thawed, it being invariably much too salt." (The doctor is here speaking of "floe" ice, of the previous winter's growth)—"but *old ice*, if projecting a foot or two above the water level, was almost invariably fresh, and when thawed gave excellent drinking water." *

* Dr. I. Rae on "The Physical Properties of Ice." See the *Manual of Natural History, Geology, and Physics prepared for the use of the Arctic Expedition of* 1875—6, by Professor Thos. Rupert Jones, 1875, p. 650.

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But Dr. Rae thinks "the ice must have been formed at least twelve months, or perhaps eighteen months" before this change takes place, and his theory respecting this remarkable phenomenon is as follows:

"When the sea freezes, I do not think (he says) that the saline matter assumes the solid state, unless the cold is very intense, but that it remains fluid, in the state of very strong brine, enclosed in minute cells. When the ice is raised above the water level, the brine by its specific gravity, and probably by some solvent quality acting on the ice, gradually drains off from the ice, and the small cells, by connecting with one another downwards, become channels of drainage." *

A small quantity of salt, placed upon ordinary lake ice *in situ*, during a winter's frost at home, as anyone will see who tries it, immediately begins to act energetically upon it; the ice begins to crackle and soon so far decomposes and becomes eaten away, that it gets quite rotten and dangerous to stand on, and the salt finally seems to pass through it, and escapes into the water below. †

Great icebergs are generally, we believe, found to consist of fresh water ice. Captain Parry for instance tells us that these "ice islands are frequently composed of pure fresh water ice, which is found in pools on the surface, or running down the sides" (during the summer time) "and watering in this manner is a general practice of ships in icy seas." §

Some of these great bergs, or 'ice islands' are often of enormous size, not uncommonly rising from 100 to 300 feet above the surface of the seas, and having a circum-

* Dr. I. Rae on "The Physical Properties of Ice," p. 650.
† Result of experiments with salt on lake ice *in situ*.
§ *Narrative of an Attempt to Reach the North Pole in Boats*, by Capt. W. E. Parry, in 1827—quoted in Roper's *Navigation*, p. 368.

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ference of many thousands of yards; when we reflect that from one sixth to one eighth part of the ice only appears above water, it conveys a still more wonderful idea of the vastness of these floating mountains of ice which must weigh many millions of tons. The question of the formation of icebergs is however still a mooted point among scientific men, but according to the *Encyclopædia Britannica*, the balance of probability seems to be opposed to the idea of their forming upon the sea itself. The thickness of ice formed by a winter's frost, authorities seem generally to agree in saying, does not exceed about seven feet in any one year, * and though exact data upon these subjects are unattainable at present, it is supposed that the great bergs are merely pieces broken off from the termination of glaciers, where they move down from the interior of the land, and reach the edge of the sea. † This of course would account for their being fresh water ice. According to the *Encyclopædia Britannica*—

"Greenland is the principal mother of icebergs" (in the Northern Hemisphere). "The whole of the interior is believed to be capped with an enormous glacier, always moving towards the coasts, and at certain points reaching the sea, where masses break off in the shape of icebergs." "Recent observations of one of the principal discharging glaciers of Greenland, show it to be 920 feet thick, and 18,400 feet wide: and that it advances at the rate of 47 feet a day during the summer season." §

This ice would of course necessarily be fresh water

* See *Encycl. Brit.*, 9th Edition. Vol. xix., p. 328.

† See *The Great Ice Age*, by Professor James Geikie, 3rd Edition, 1894, p. 47.

§ *Encycl. Brit.*, 9th Edition., Vol. xix, p. 329. (Article "the Polar Regions").

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ice. Researches in the arctic regions to the north east of Behrings Straits also show that immense ice cliffs formed of pure ice exist "at Cape Maitland, in Liverpool Bay, from 80 to 100 feet high," which "present to the sea a constantly frozen wall." *

Similar ice cliffs, but still more gigantic in size and of enormous extent, were found in the antarctic ocean by the South Polar Expedition, under Captain Sir James Clark Ross, in 1843, who traced them extending practically without a break for a distance of 450 miles, from Long. 100 E. to Long. 165 E., mostly in the 75th to 78th parallels of latitude. †

This great range of ice cliffs is entirely unexampled in any other part of the world, and proves beyond question the much greater severity of the climate in the South Polar regions, compared with anything yet discovered in the northern, and shows the stupendous magnitude and thickness of the Paleocrystic ice, which exists within the antarctic circle. This great ice barrier, so far as could be ascertained, was from 180 to 200 feet in height. It seemed to be flat on top, and to form the seaward face of an enormous collection of ice and snow, which had probably been in process of formation for thousands of years.

The ancient ice in the antarctic regions was also found to extend much further from the pole than it does in the arctic; and a violent succession of heavy gales appear to succeed each other throughout the

* *Zoology of the Voyage of H.M.S. Herald*, by Sir John Richardson, Edited by Professor Edwd. Forbes, F.R.S., 1854, p. 5.

† See *Voyage of Discovery and Research in the Southern and Antarctic Regions*, by Capt. Sir James Clark Ross, R.N., 1847., Vol. i., p. 232. (Some plates of this wonderful ice barrier are given in Vol. i. of Sir J. C. Ross's work).

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whole antarctic ocean at short intervals all through the summer, so that in every way the dangers of navigation and the severity of the weather, were far greater in the antarctic seas than anything that has been met with in a corresponding latitude in the northern hemisphere. Captain Sir James Clark Ross however, succeeded in penetrating as far as Lat. 78° 4′ S., Long. 161° E. in 1841, * and since then, very little has been done in the way of antarctic exploration. A new South Polar expedition was however proposed by an Exploration Committee at Melbourne in 1890; and public subscriptions were invited to make up a sum of £15,000 which was required for this purpose, † but the idea had to be abandoned for want of funds.

Since then the antarctic regions have been brought prominently into notice by a most remarkable movement of the southern ice, which appears to be of so gigantic a nature that it exceeds everything of the kind that has ever been recorded during historic times. It would appear to be caused, almost certainly, by some vast volcanic convulsion occurring in the unknown solitudes beyond the great antarctic ice barrier, where it is known that at least one or more active volcanoes exist. It would be difficult to account in any other way for the tremendous movement which has taken place there amongst the ice. Bergs, or rather islands, of a size which enormously exceeds anything ever before heard of, have been hurled into the sea in great numbers, and these masses have gradually

* Raper's *Navigation*, 19th Edition, 1891, p. 628.

† See *Haydn's Dictionary of Dates*, 20th Edition, 1892. The matter was again keenly debated in the Australian press in the spring of 1895.

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drifted northwards into the track of vessels both in the Atlantic and Pacific Oceans. Even in the Indian Ocean many great icebergs have been sighted by ships bound to Australia, in the usual track of vessels. The obstruction created by the ice has also been very great within a short distance of the New Zealand coast.

The *Morning Post* (London) in a most able and interesting article on this subject, says,

"Some idea of the extent of this obstruction may be formed from the fact that it necessitated a steam ship losing two days, in making a detour to regain its proper course."

But the ice here appears to be relatively trifling, compared with that seen in the South Atlantic. There there is a current setting from the southwards, past Cape Horn towards the Falkland Islands, and on this the same article says,

"Hundreds, if not thousands of gigantic bergs, have been floating into mid ocean as far north as Lat. 37° S., and it is likely that ere long vessels bound round the Cape of Good Hope will fall in with these dangers." "Ice," it proceeds to say, "is often seen on the Newfoundland Banks a few miles in circumference, and from 50 to 250 feet high, but the largest of these dwarfs into insignificance beside the monsters from the South Pole. Some of these bergs are at least *50 miles* in length, those of 10 miles and upwards being numerous." The fields of ice have been extending for 400 miles and "bergs of 200 feet high are common, several have been reported of 1000 feet, and one is said to be 1500 feet."

Fortunately the shipping casualties were few, one vessel however collided with one, and had to be abandoned, and in the West India Docks, London, there were at the time the above article was written some half a dozen

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ships which reported injuries of a more or less severe nature.

"But there have been hairbreadth escapes, and captains at the docks relate most thrilling accounts of the dangers they have passed through. As a spectacle some of these officers report that nothing can be grander or more tremendous than those majestic icebergs." *

The danger to shipping of meeting icebergs at sea by night or in fogs is of course very great—in detecting their presence no reliance is to be placed upon the thermometer, for a variety of reasons, too long to go into here, but which are fully stated in the authority from whose book we quote. It is therefore, we are told—

"much better to go quite slow, keep a hand aloft and on the forecastle, stop the ship occasionally, and listen for the sound of breakers, or the echo of the steam whistle;" also "a large iceberg will denote its presence even on the darkest night, by a sort of whiteness or halo, known as 'ice blink.'" †

Such we are assured, are the principal precautions which experience suggests for the guidance of seamen on these trying occasions.

It has often been supposed that when ships came to the end of navigable limits in the polar regions, explorations could be pushed forward by means of sledging parties, travelling over the ice until they reached the pole. Unfortunately arctic experiences thus far seem to preclude the hope of success which

* See Article in *Morning Post* of June 7, 1893. (Assuming the relative proportions between the submerged portion of these icebergs to be about 7 parts to 1 part appearing above water, it follows that a berg 1500 feet high over sea level—mentioned above—would represent a mass of ice 10,500 feet thick).

† See *Wrinkles on Practical Navigation*, by S. T. S. Lecky, Master Mariner, Comr. R.N.R., Edition 1887, pp. 219, 220.

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was so confidently anticipated from attempts of this nature. As we have already mentioned, the exceedingly rough nature of the ancient ice renders sledge travelling impossible; over wide areas of frozen sea the rise and fall of the tides is continually breaking up the ice fields; and the enormous pressure of the surrounding ice piles up immense broken masses of it, one layer above the other, in such chaotic confusion, that the whole landscape resembles rather a series of hills, composed of huge blocks of ice, than a smooth frozen plain, such as popular fancy seems to have pictured as the normal aspect of an arctic ice-bound sea. Over such a surface, travelling parties with sledges have to slowly force their way, climbing up to the crest of one elevation, and painfully dragging the heavily laden sledges, with infinite labour, after them, and then lowering them down as best they can on the opposite side. It is therefore very evident that long before they could possibly reach the pole, their provisions would be exhausted, and famine would force the adventurers to beat a retreat. The sailing orders issued by the British Admiralty to Sir George Nares, * for the guidance of his expedition, fully recognised this difficulty, and pointed out, in distinct terms, the extreme improbability of successful results following upon any attempts of the kind.

Paragraph No. 15 of these orders runs as follows:

"It must not be lost sight of, that in the absence of any continuous land, sledge travelling has never yet been found practicable over any considerable extent of unenclosed frozen sea; although conditions may be found to exist which would enable parties to travel for limited distances by sledge and

* Dated May 20th, 1875.

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boat operations combined; and for this purpose the best boats and sledges that can be devised, have been supplied." *

The results of Commander Markham's sledge journey subsequently proved the wisdom and correctness of these instructions. With infinite labour, and at very great risk, that officer succeeded in pushing forward to within just 400 miles of the Pole, but he was then from these very causes forced to retire, after penetrating but a comparatively short distance further than previous attempts had succeeded in doing, and planting the British ensign in the midst of eternal snows, at a somewhat higher latitude than had up to that time been reached.

Sledging journeys are practically restricted to the spring and summer time only. The darkness of the long winter's night of course precludes the possibility of travelling over such a description of country at that season; and the soft state of the newly fallen snows renders travelling impracticable in autumn and early winter: at that time men sink so deeply into them that extensive snow fields become almost impassable. Snow in these far northern regions falls in an extremely fine dustlike flour, and not in the large flakes which are usual in England; in this exceedingly fine state it is of course blown about by the least puff of wind, † and so forms blinding clouds of snowdrift, which render it impossible for travellers to guide their course without constant reference to the compass; in a few moments

* Extract from Admiralty Sailing Orders, addressed to Captain Sir George Nares, R.N., given on page XIV of preface to his *Narrative of a Voyage to The Polar Sea*, 1878, Vol. i.

† *Voyage of the Vega*, by A. E. Nordenskiold, translated by Alexander Leslie, 1881, Vol. i, p. 473.

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also, all foot-prints and other traces of their passage are completely obliterated.

"Day after day (says Baron Nordenskiold) during the winter, drifting snow was so thick that the dark hull of the vessel itself could be distinguished only when we were in its immediate neighbourhood." *

This sort of snow is however perfectly dry, and brushes or shakes off clothes exactly like dry dust, and is as light as a feather; in Canada such snow is consequently known as "poudré" and it is generally supposed there that it takes about eighteen inches of it to make one inch of water. Of course in this fine state, when there is a wind it penetrates everywhere, no crevice seeming to be too minute to allow it to make its way through; in log houses therefore newly-arrived settlers are often surprised in Canada, on awaking in the morning, to find quite a little bank of snow formed on the floors of their houses, by the drift getting in through some small chink in the boards or under doors etc., etc. On account of the descent of the polar cold into the Temperate Zone, during the Canadian winter, its temperature is often so low that in winter camps it is no uncommon thing to see a shelter wall of snow, banked up around them to a height of four or five feet, remain standing unaffected by the fierce blaze of a large fire burning close to it—the heated and rarefied air from the camp fires in the still atmosphere seeming to rise almost perpendicularly, and in the intense cold, to throw out

* *Voyage of the Vega*, by A. E. Nordenskiold, translated by Alexander Leslie, 1881, Vol. i, p. 473.

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rays of heat but a very short distance laterally. The extreme dryness of everything at the same time renders the cold less perceptible than might at first be supposed, especially where men are enveloped in good buffalo robes or other furs. Very beautiful are the effects which are often produced by the masses of soft white snow, looking like so much fleecy wool, which covers the whole face of nature, and clothes the trees and rocks with a glistening mantle of spotless white, festooned in the softest and most elegant drapings. During severe snowstorms the scene is often of the dreariest character imaginable, the wind whistling wildly across the desolate waste and the dense, swirling clouds of "poudré," frequently rendering travelling almost or even quite impossible. But when the snow has ceased to fall, and the storm is over, these winter camp scenes, notwithstanding the great cold, are almost always looked back upon by those who have had experience of them, as among the incidents best worth remembering of their existence; the great snow-covered solitude, the pendant branches of the spruce trees and white-barked birches stretching forth in the then perfectly still atmosphere, loaded with fleecy snow; the vast extent of frozen lake and river—all combine, with the mighty hush of Nature, to produce one of the most picturesque and impressive tableaux which it is possible to meet with anywhere. Another charming effect seen in winter, is the "Silver Thaw," which generally appears as the result of recent heavy fogs, whose rime descends and congeals upon the branches and twigs of trees etc., depositing upon them a layer of ice particles, so that sometimes each tree has the appearance of a great chandelier of

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crystals. * The Aurora Borealis is another phenomenon everywhere visible throughout the arctic regions, which is seen in Newfoundland, according to the same authority, "in exceptional brilliancy and finer even than in the arctic regions." †

Be this as it may, in fine weather the still glory of an arctic night constitutes a spectacle of majestic grandeur, which in its way is unexampled in other lands. Even in the most northern regions yet visited by man, according to Dr. Moss,

"The weather during winter is as a rule so calm and clear, that observations on the stars can be made almost at any time. But it was not a little remarkable (he goes on to say) that even at the clearest time, some icy dust, too fine to be called snow, was always falling." §

These ice crystals sometimes seem to fall in considerable quantities; and the phenomenon is by no means confined to the arctic zone only, for we have seen showers of these minute crystals falling during the brilliant sunshine of a cold day at home, glittering like gems of the purest water, as they slowly descended through the sunlit atmosphere, and as regards their quantity—in the Polar Regions,

"On the 27th December 1875, at the winter quarters of the *Alert*, when it was so clear that a star of the 3rd magnitude less than three degrees from the horizon could be satisfactorily observed," Dr. Moss says that "in 12 hours, a glass plate exposed on the top of a neighbouring hill collected a quantity of little crystals, equal to nine tons per square mile."**

* See Description of Winter in Newfoundland in *Colonial Year Book* for 1892, by A. J. R. Trendall, p. 76.

† *Ibid.*, p. 76.

§ *The Shores of the Polar Sea*, illust. folio by Dr. Edwd. L. Moss, M.D., 1878, p. 44.

** *Ibid.*, p. 44.

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These icy particles, if we might venture to hazard an opinion on the subject, proceed from upper currents of air, passing in the great altitudes, still carrying with them some slight quantities of watery vapour, which the exceeding keenness of the arctic cold causes to become frozen, and to be precipitated upon the earth in this way, in the form of very minute ice crystals. The rapid and progressive increase of cold, as the altitude increases, is well known, and throughout the great regions of illimitable space it represents a figure of which we, the dwellers upon the earth, can form not even the faintest conception even from our lowest recorded temperatures. Dr. Croll for instance mentions in his remarkable work upon "Climate and Time in their Geological Relations," that "the Temperature of Space as determined by Sir John Herschel is —239° Fahr.," and he adds that "Mons. Pouillet by a different method, arrived at almost the same result." *

Here moreover we touch upon a technical point of very great importance—namely the evident existence of aqueous vapour in intensely cold form in the higher atmosphere of the polar regions. As a rule any considerable lowering of the temperature is sufficient to convert this watery vapour into either snow or rain. It is then precipitated, and we have several times called attention to the fact that even the passage of air over lofty mountains causes the apparently almost complete condensation of its vapour. The fall of these icy crystals during still weather throughout the polar winter, and the occurrence of heavy snowstorms as far northward as man has been known to penetrate, proves however,

* *Climate and Time in their Geological Relations*, by James Croll, LL.D., F.R.S., 1885, p. 323.

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that the air of these regions still remains charged with vapour whose temperature must at the very least be 100° F. below freezing point and probably a good deal below even that point. It is therefore evident that we have a great deal yet to learn before we can form even an approximate idea of the true conditions of the atmosphere at great heights or of the capacity of watery vapour to exist as such under conditions of intense refrigeration.

These wonderfully clear nights in the arctic regions are always very cold, very still, and very dry; and their matchless serenity is periodically lit up by the silver light of a moon of such exceptional brilliancy that everything can be seen by her light almost as clearly as if it were daylight.

"The moon (says Sir George Nares) is truly the presiding goddess of the arctic nights, reflecting to us, during each of her visits, the light of the absent sun, for ten successive days and nights, as she circles round the heavens without ever setting." *

The stars also shine with a lustre and a brilliancy to which even the beauty of our fine winter's nights at home can display nothing to compare with—and these "lesser lights" which, in the language of the Scripture, "rule the nights" are so far reflected from the snowy surface, that the whole landscape is clearly exhibited all round for long distances, white, solemn, and motionless: everywhere wrapped in its winding sheet of spotless snow, and still and silent as the tomb.

It is at these times that the grand spectacle of the Aurora Borealis is commonly most brilliant. It is an

* *Narrative of a Voyage to the Polar Sea*, by Capt. Sir George S. Nares, R.N., 1878, Vol. i, p. 191.

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electrical phenomenon most frequently seen in high latitudes "in the form of luminous clouds, arches and rays, of which the latter sometimes meet at a point near the zenith, and form what is called a Boreal Crown." *

The reader will doubtless remember the observations we have already made upon the highly charged electrical state of the atmosphere, alike in great heat and great cold, and these wonderful "Northern Lights," as they are often called, are but another exhibition of its effects—by no means however exclusive to these high latitudes, for it is often finely seen in Canada, and elsewhere, and even in our own country. On the night of the 24th of September 1870 for instance, a beautiful Boreal Crown was visible in the North of Ireland, the whole northern horizon being constantly lit up by brilliant flashes of flickering light, something similar in appearance to what we see nowadays on the display of a powerful electric light by naval vessels at sea. Almost every book of arctic voyages contains descriptions of the magnificence of some of these displays, and not a few of them contain plates, giving illustrations of the peculiar effects which were produced. The long and rigorous night of an arctic winter therefore is not wholly destitute of some softening and mitigating circumstances. Dreary and desolate as it always must be in its main features, there are still these glorious and singularly beautiful displays with which the Divine Wisdom has tempered the darkness of this great night, during which the shadow of the earth rests upon the Polar Regions for a continuous period of several months' duration.

* *Encycl. Brit.*, 9th Edition, Vol. iii, p. 90.

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The departure of the winter—following upon the return of the sun, and the breaking up of the ice pack—is also the signal for another wondrous display of power, compared to which all other natural phenomena may well seem small in comparison; and the frightful noises which frequently accompany the setting in motion of all these millions of tons of ice at times exactly resemble the discharge of heavy artillery. The consequent perils to which ships beset in the ice are always exposed at this season, and the utter powerlessness of their crews to do anything to avert a destruction which seems inevitable, are matters of fact, related in almost every book of arctic travel.

The advent of spring is generally heralded in these regions by the softening of the snow; and its beginning to ball under the foot in northern countries is generally regarded as the first indication of approaching spring. When the thaw sets in the ice becomes quickly rotten and its rapid break-up then becomes only a question of days. The enormous weight and grinding power of these great frozen masses is so great that nothing can withstand it. The strongest ship if brought into direct contact with it, would be crumpled up like so much brown paper: and many instances are recorded of ships being lifted right up out of the water and cast upon the top of a pile of debris like pieces of floating chips. Nevertheless on the dispersal of the ice below, they have often been known to settle down again, and effect their safe escape into open water. It was a circumstance of this kind however that led to the loss of the ill-fated Franklin expedition. Nowhere in fact do the puny efforts of man appear so futile to control events, or so powerless to save, as upon these occasions.

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This constant sense of ever-present danger has consequently had such an effect upon the mind, that many of our most renowned navigators in these seas have been men whose valour has been equalled only by their piety; and we find frequent reference made in their works to passages taken from the Scriptures, which appear applicable to their helpless condition.

Among the many striking and dramatic passages, descriptive of the various phenomena of Nature, with which the pages of Scripture are filled, we append some of those immediately relating to the cold and snows of the winter season:—

Behold (says the Scripture) the nations are as a drop of a bucket,
And are counted as the small dust of the balance.
Behold, He taketh up the isles as a very little thing. *

He sendeth forth His commandment upon earth:
His word runneth very swiftly.
He giveth snow like wool:
He scattereth the hoar frost like ashes.
He casteth forth His ice like morsels:
Who can stand before His cold?
He sendeth out His word, and melteth them:
He causeth His wind to blow, and the waters flow. †

Out of the south cometh the whirlwind:
And cold out of the north.
By the breath of God, frost is given,
And the breadth of the waters is straitened. §

Who hath divided a watercourse, for the overflowing of waters?
Or a way for the lightning of thunder.
To cause it to rain on the earth, where no man is:

* Isaiah xl, verse 15.
† Psalm cxlvii, verses 15—18.
§ Job xxxvii, verses 9—10.

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On the wilderness, wherein there is no man.
To satisfy the desolate and waste ground,
And cause the bud of the tender herb to spring forth.
Hath the rain a father? Or who hath begotten the drops of dew?
Out of whose womb came the ice?
And the hoary frost of Heaven, who hath gendered it?
The waters are hid, as with a stone,
And the face of the deep is frozen.
Canst thou bind the sweet influences of the Pleiades,
Or loose the bands of Orion?
Canst thou bring forth Mazzaroth in his season:
Or canst thou guide Arcturus with his sons? *

Almost, on reading these passages, one might suppose that the writers had been visitors to the arctic regions, and were familiar with the aspect of the frozen deep, the descent of the snows, the sealing up of the waters, and the great break-up of the ice in spring caused by the return of the sun and the setting in of the southerly wind. The epoch at which the book of Job was written is uncertain, but it is supposed by some of the ablest commentators, both of the Jewish and the Christian churches, to date from a very early period, † and the singular beauty of some of its passages is of a very striking character; the original was written as a poem, concerning which Calmet, in his Dictionary of the Bible, says,

"We believe that there is not in all antiquity a piece of poetry more copious, more lofty, more majestic, more adorned, or more affecting." §

* Job xxxviii, verses 25—32.

† See the *Dictionary of the Bible*, by Dr. William Smith, 1863, Vol. i, pp. 1095—6. (Article "Job").

§ See *Calmet's Dictionary of the Bible*, 14th Edition, 1861, p. 544 (Art. "Job").

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The mention of no less than three of the finest of those constellations which we may see still glittering in the celestial vault, after the lapse of some 3000 years, is remarkable and also unique in the Sacred Writings. The Pleiades as we know, with their cluster of seven little stars, * still appear unchanged in the constellation of Taurus. The giant Orion, of the Arab astronomers, which almost every child can point out, still shines the greatest and grandest of all the constellations, high in the zenith, in Biblical lands. A line drawn through its belt, on the *opposite side* from the sword, takes the eye close to a large V, on top of one of whose sides, not far from the Pleiades, is seen a bright and ruddy star "*Aldebaran*" (Alpha of Taurus) which is much used for Nautical observations; whilst Arcturus, of the constellation "Bootes," the brightest gem of the strictly northern heavens, is at once found by following an imaginary continuation of the curve of the tail of the great bear (*Ursa Major*), which leads us straight, and without the possibility of any mistake, to *Arcturus*. † The somewhat obscure allusion to "*his sons*" is supposed to refer to neighbouring and attendant stars, in all probability to those of the "Great Bear" itself, as the name seems to imply; the word "Mazzaroth" is of doubtful interpretation but Dr. Smith in his Dictionary of the Bible believes it to be a general name for the "signs of the zodiac." §

In view of the numberless dangers, difficulties, and

* Only six of these stars are visible to the naked eye, of which the star "Alcyone" is the brightest. This constellation is however much brighter and more clearly visible in the Southern Hemisphere, than it is in the Northern.

† The name is derived from the Greek **αρκτος**, 'bear' and **ουρα**, 'tail.'

§ See Dr. Smith's *Dictionary of the Bible*, Vol. ii. (Article "Mazzaroth"), p. 281.

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discomforts, to say nothing of positive sufferings, which every arctic voyager is certain to encounter, during a residence in high latitudes, it might be supposed to be mere affectation on the part of anyone to say that these dreary wastes of ice and snow, could be possessed of attractions; or that a man who had once experienced their privations, could be otherwise than glad to escape for ever from their influences. Nevertheless their stern and desolate grandeur, and a certain sublimity which is inseparable from an Arctic scene, unquestionably *do* exercise a very strong fascination over many minds, and surprising as it may seem to be, there is ample evidence to show that men who have once become familiar with the great Northern Wilderness, in a great many cases, for ever afterwards experience an unaccountable desire to revisit it, and explore still further into the mysteries of this great unknown country:—it is but another example of that powerful fascination which a life of adventure in the wilderness is always found to exercise over mankind, in every region upon earth, and it would appear that no amount of danger to life, or risk to health, has ever been sufficient to damp the enthusiasm of explorers or permanently to arrest their progress.

Now, though the generally extremely healthy character of the arctic regions has never been questioned, experience has shown that few European constitutions can bear the rigours of the climate for more than a couple of successive seasons, without the health becoming affected by it, and that there is no such thing as acclimatization to great cold, any more than there is to the influences of great tropical heat.

In both cases, as time runs on, residents become

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more sensitive, instead of less sensitive, to the influences of the climate. These facts as regards European residents in tropical lands are now well ascertained, and also seem to be so with regard to arctic cold, though of course experiences with respect to it are much less numerous than in the former case.

The monks at the Convent of St. Bernard amid the eternal snows of the high Alps, for instance, where a positively arctic climate exists for the greater part of the year, say that as a rule they find a return to the plains absolutely necessary, for nearly all the members of their community, after a residence at the top of the pass for a couple of years. * It may therefore be taken as a matter of ascertained fact, that exposure to very great cold is not compatible with perfect health for more than a very limited space of time.

The immense length of the Polar night in far northern latitudes has also a very depressing effect upon many men—it lasted for a period of 138 days, for instance, at the winter quarters of the *Alert*, in Lat. 82° 27′ N., and Dr. Moss, one of the medical officers on board, assures us, that its terrible tedium is far more trying than the cold, which he says—"is not nearly so trying as the long darkness, and both are insignificant compared to the friction of the confined life." † Nevertheless there was very little sickness on board the *Alert*, or indeed on board any of Her Majesty's ships which have wintered in the arctic regions, since the means of avoiding scurvy have been better understood—and a remarkable fact is, how often we

* Statement made by the monks to the Author, in reply to questions, during his visit to the Great St. Bernard.

† *The Shores of the Polar Sea*, by Dr. Edwd. L. Moss, M.D., 1878, p. 47.

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find officers and men who have once taken part in arctic expeditions, go back again and again to these regions whenever opportunity offers.

In the sub-arctic regions, adjoining the southern margin of the regular arctic zone, however, where the summers are considerably longer, and the winters very much shorter, the briefer period of cold, though perhaps quite as severe while it lasts as it is in places much further to the northward, does not appear to produce any markedly unfavourable effects, or to be at all incompatible with the enjoyment of perfect health. The experience of the Hudson Bay Company's officers and men seems to be conclusive upon this point. It is in these barren grounds of Northern Canada therefore, and in other similar countries, that we so often find these instances of people who have become so much enamoured of an arctic climate and arctic scenery, that they seem to prefer it to almost any other.

Many of the Hudson Bay Company's officers, in former days, used to be stationed for years in small trading posts, or forts, in the northern wilds, where they were often altogether cut off from communication with the outer world, except on the one occasion when each season a boat or pack train arrived, bringing up the Indian trade goods and other supplies for the fort, and took away the collection of furs, made since the previous year, on the return journey. There were even one or two posts in the far north where a letter took *two* seasons to reach them, as we were credibly informed. Yet these men, most of them Scotchmen, and half-breed Canadians, were generally eminently happy and contented. A few now and then gave up their posts, and retired in disgust; but after

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their return to civilization, they in perhaps the majority of cases seem to have experienced this strange longing, of which we have spoken, which impelled them to return to the wilds again; and many of them actually did so. We have repeatedly heard this subject discussed by officers and others belonging to the Company, when we were in the Hudson Bay Territories, and all were unanimous in maintaining that such was the case, and we can have no doubt whatever of its truth.

Dr. Gordon speaking on this subject says:

"The spell of the Hudson Bay Company's service seems as vague, though as powerful, as that which binds a sailor to his sea-faring life, which he may often abuse, but never abandon. Its agents may be attracted by the utter freedom it gives, and the opportunities of sport which most of them delight in. Ask them *what* fascination they find in it, and they can hardly tell you, and they have scarcely a good word for the service; only when an outsider finds fault with it, they speak in its defence. And yet let them leave it for a time and they long to come back to it." *

This coincides precisely with what we have heard and known while out there, and similar testimony might be cited from the works of various writers to the same effect. Colonel Butler, a well-known writer on military and sporting subjects, for instance, in speaking of his recollections of some of his journeys through these territories during the most severe season of the year, says—

"The camp, the lonely meadow, the dim pine woods, the

* *Mountain and Prairie*, a journey from Victoria to Winnipeg, by the Revd. Daniel M. Gordon, D.D., 1880, p. 137.

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snow-capped mountains, the mighty hush of Nature, as the great solitude sunk at sunset into the sleep of night, all came back to me in a thousand scenes of memory. I would go back to it again. Is there anything on earth better than this wilderness? Is there aught in this short life of ours, with less of that pleasure which is sure to turn to pain? With less of those things which are sweet, while we toil towards them, and bitter when they lie behind us on the road of life?" *

Mr. Warburton Pike also in his recent work "The Barren Grounds of Northern Canada," is most emphatic in insisting on the same sentiments.

"A man who has spent much of his time (he says) under the influence of the charm which the North exercises over everybody, wants nothing better than to finish his life in the peace and quietness which reigns by the shores of the Great Slave Lake. Ask the priest, when you meet him, struggling against a head wind and driving snow, on his way to some Indian encampment, whether he ever sighs for his sunny France. 'No,' he will tell you. 'Here, I have everything I want, and nothing to disturb my thoughts. I enjoy perfect health, and feel no desire to go back to the worries of the great world'—and so it is with the fur trader: the mysterious charm has a firm hold on him, and if he is in charge of a post where provisions are fairly plentiful, and the Indians not troublesome, he has a happy life indeed." †

Mr. Pike goes on to say that he "is writing these concluding lines" of his book (quoted from above) in a fashionable garret off St. James's Street, London, surrounded by all the luxuries that only ultra-civilization can give, without the necessity of tramping "many

* *Far-out Rovings*, retold by Lt.-Col. (now Maj.-General Sir) W. F. Butler, C.B., p. 20.

† *The Barren Grounds of Northern Canada*, by Warburton Pike, 1892, p. 213.

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weary miles, on snow-shoes, before you even get a sight of your dinner in its raw state"—and yet—he longs to go back again to the wild hunting grounds far out in the dim wilderness of the frozen North.

"On looking back (he says) one remembers only the good times, when meat was plentiful, and a huge fire lit up the snow and the spruce trees, and even now, in the midst of luxury and civilisation, at times I have a longing to pitch my tent once more at the edge of the Barren Ground: to see the musk-ox standing on the snow drift, and the fat caribou falling to the crack of the rifle; to hear the ptarmigan crowing among the little pines, as the sun goes down over the frozen lake, and the glory of an arctic night commences. To the man who is not a lover of nature, the Barren Ground must always be a howling and desolate wilderness: but for my part, I can understand the feeling that prompted Saltatha's (the name of one of his Indians) answers to the worthy priest, who was explaining to him the beauties of Heaven. 'My father you have spoken well! you have told me that Heaven is very beautiful! tell me now one thing more. Is it more beautiful than the country of the musk-ox, in summer, when the mist blows over the lakes, and the water is blue, and the loons cry very often. That is beautiful; and if Heaven is still more beautiful, my heart will be glad; and I shall be content to rest there till I am very old.'" *

Such in brief is the unanimous testimony of those who have enjoyed the wild freedom of existence in these countries, though it is notorious that the climate of the Great Slave Lake district is one of the severest in the Hudson Bay Territories, and quite as cold in winter as almost any place that could be found; and yet still its wild mysterious charm haunts the

* Closing paragraph of *The Barren Grounds of Northern Canada*, by Warburton Pike, 1892, p. 276.

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traveller, amid the ease and luxury of a London dwelling house.

We have thought it right to close this section with a record of these strange yet powerful attractions, common alike to the Indian and to the civilized man. Such sentiments will always be found strongly developed among so-called savage races—and the Eskimo, and all the northern tribes who live along the shores of the great frozen sea, are deeply imbued with them. It is not that these regions are free from their known and serious draw-backs. Even while admitting them to the fullest extent, it is nevertheless clear that there is still something amid the ice and snows of the great northern winter, which is capable of engaging the affections of every human beholder.

So also in the animal world. Just as the Israelites of old journeyed towards the promised land, so vast herds of animals annually migrate, by long and painful marches, from far off countries and sunnier climates, to rest at length in peace, and bring forth their young in these inaccessible wilds; innumerable flocks of many kinds of birds fly, as we have endeavoured to show, literally for thousands of miles, from the southwards, to come and nest in tranquillity amid the same, filling the air with the voice of joy and gladness.

Even in these far-off solitudes therefore, the wild beauties and sublimity of Nature are not displayed in vain; for notwithstanding all the rigours of an arctic climate, they have lost nothing of their charms—nothing of their attractions—nothing of their glory.

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CHAPTER XI.

THE REGION OF THE GREAT MOUNTAIN RANGES.

Geological Changes on the Earth's Surface. Continents Raised from Beneath the Ancient Seas. Basin of the Present Sea. Lands form Elevated Plateaux Around it. Their Average Height. Mean Depth and Area of the Ocean. The Ocean as one Continuous Liquid Expanse. Submarine Mountain Ranges. Islands as Elevated Peaks and Plateaux. The Question of Island Life. American Mountain Ranges. Spurs or Lateral Ranges. The Rocky Mountain System. The Andes System. Probable Results of Upheavals. Fossil Marine Shells Found at Great Altitudes. The Sedimentary Rocks. The Evidences of Upheaval. Compression or Shrinkage. Distinction between Plutonic and Volcanic Rocks. Contortions of Sedimentary Rocks. Sedimentary Rocks, Raised in Situ, as Plateaux between Mountain Ridges. Parallel Chains. Their Elevation Probably Simultaneous. Upheaval of the Alps. The Earth's Crust. The Age of Mountains. The Process of Denudation. Ice Wedges. Their Effect in Loosening Rock. Expanding Power of Ice. Action of Rains. Landslides. Mountains Originally much Higher than at Present. Slopes of Detritus at Bases of Mountains. The Indian Terai. The Great Plain of Northern India. The Question of its Formation. Tertiary Rocks Underlying the Indian Plain, Flexed Upwards at the Foothills of the Himalayas. Their Fossils all Marine. Crystalline Rocks Form the Higher Peaks. Proofs thus Furnished of the Great Antiquity of the Earth. Whence did the Materials for the Plain Come From? The Question of its being the Detritus of More Ancient Ranges. Estimate of Bulk of Existing Asiatic Ranges. Age of Existing Ranges. Volcanoes. Mountains Generally *not* Volcanic. A Great Mountain Range the Result of some Gigantic Convulsion of Nature. Probably a Single Operation and *not* a Series of Detached Efforts. Vast Antiquity of Mountain Ranges. Rock-cut Gorges. Influences of Mountains on Climate. Line of Perpetual Snow in the Tropics. Causes of Variations of Snow Lines. Himalayan Snows. Snows on the Andes. Peruvian Droughts. The Desert of Atacama. Region of "La Montaña." Ranges of Climate on the Slopes of the Andes. Ranges of Plant Life on Mountain Sides. The Pass from Guayaquil to Quito. Magnificent Scenery. The City of Quito. Trails descending into the Tropical Plains.

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The "Tablazo" or Plains Country of Peru. "La Garua" or Fog Season. Climate and Rainfall of Kashmir. Snow-fed Rivers and Crops. Climate of Ladak. The "Zoji La" Pass. Climate of Central Asia. Rapid Variations of Temperature. Sun's Rays often more Powerful than in India. Puña or "Mountain Sickness." The Heart's Action in Mountaineering. Effects of Rarefied Air. The Value of Tropical Hill Stations as Sanitaria. Sudden Ascents in Cases of Malarial Disease Unwise. Darjeeling. Mount Senchal. The Story of the Senchal Cantonment. Magnificent Panoramas. The Gorge of The Great Ranjit. Distant Vistas of the Indian Plains. Flowering Shrubs and Trees. Malaria and Ravines. Deadly Climate of the Terai. Ravines as Conduit Pipes for the Conveyance of Malaria. Malarial Fever in the Mountain Districts of Central Africa. Sudden Ascents to Hills often Precipitates an Attack of Fever. Daybreak in the Himalayas. Ascent of Fogs from the Ravines. Fog Drift across the Crest of Ridges. Mount Everest seen from Tiger Hill. High Mountains in Dry Plains becoming Snow-clad. The Indian Monsoon. The Himalayan Snows. Mountains as Rain Condensers. Snow-Streams. Their Rock-Cutting Power. The Great Iskardoh Gorge of the Indus. Military Strength of the Indus Frontier of N.W. India. Attock. Sudden Floods on the Indus. Loss of Ranjit Singh's Cavalry while Crossing a Ford. Carrying Force of Mountain Torrents. Torrents generally Independent of Rains. Floods caused by Sun acting on the Snows. Freshets in the Rivers of the Punjab. Sacred River Sources in India. Sources of the Ganges. "The Sacredness of High Places." Buddhist Temples. Rock Temples of India. Egyptian Rock Temples. Abu Simbel. Indian Figures of Buddha. The Mountains of Moab. Balaam's Parable. The Hill Tribes of Canaan. Splendid Panoramas from Mountains. Looking out from the Himalayas upon the Indian Plains. Panorama from a Central African Mountain. Mountain Storms. Their Grandeur. Dangers of Storms at Great Altitudes. Loss of Travellers in the Snow. Destruction of a Mule Caravan in Kashmir. Caravans through the Khyber Pass. Great Himalayan Passes. Immense Altitudes of Some of Them. Snow Lines of the Andes. State of Snow at Great Altitudes. Alpine "Tourmentes." Dust Avalanches. Ground Avalanches. The Rush of Air with Avalanches. Geographical Distribution of Plants on Mountains. Mountain Forests. Professor Meyen's Phytogeographical Divisions. Range of the Banana. The Cocoa Nut Palm. Examination of Jungle Tracts on Mountains. Limits of Palms etc. Limits of Deciduous Trees. Conifers. The Bush Belt. The Glacial Region. Vegetation on the Glacial Region of Chimborazo. Earth Worms and Butterflies at Great Elevations. British Government Expedition to Yarkand. Difficulties of Cooking at Great Elevations. Testing Heights by Thermometers. Penetrating Nature of Cold at Great Altitudes. Prevalence of Toothache on High Mountains. Game at Great Altitudes. Mountain Shooting. Wild Goats and Sheep. American Wild Sheep. Ascent of Game from the Plains in Summer to avoid "The Fly." Pasture Lands at High Altitudes. Alpine Flowers. Cautions to Mountain Climbers and Hunters. Concluding Remarks.

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MOUNTAINS run, as we know, in detached masses through all the climatic zones, and it is also a remarkable fact that what we may call the "Axis of Upheaval" or elevation, is from East to West in the Eastern Hemisphere, or Old World; while in the Western, or New World of America, it runs from North to South: showing how the great forces of Nature have in these cases acted almost at right angles to each other—and also it is to be observed that they always operate in the direction of the greatest length of a continent.

Geology teaches us that the whole surface of the earth has from time to time been subjected to these changes: those portions of it which are now dry land having been at one time submerged beneath the bed of the ancient sea; whilst many parts now overflowed by its waters have undoubtedly formed part of the primeval continents. It is only necessary to point to the fact of marine shells, corals, sea fish, and other remains being found embedded in the rocks, which are now raised high above the present water level, to prove that though these rocks may, in some cases, form the tops of mountains now, they must at some former era of the world's existence have been buried during vast periods of time beneath the waters of the sea.

These considerations of course open up great questions of geological science which it would be too long to discuss, and which are also foreign to the scope of this work. We shall not attempt therefore to enter into them except in the most general terms. Those who may feel interested in such questions will find the whole subject very fully discussed in the text books of the specialists who have written upon it. Nevertheless there are a few

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of the leading points which, we feel, will require to be briefly noticed in this section.

In our chapter upon "The Ocean and the Inhabitants of the Mighty Deep" we shall take occasion to point out the enormous extent of the great region which forms the basin of the present terrestrial sea, and the great depth at which its bed is submerged beneath its waters.

It is evident that could we behold this mighty basin —which is so dramatically described in the Scriptures, as representing the hollow of the Great Creator's hand—and could the range of our vision extend to its boundaries—we should see those portions of the earth's surface which now form dry land, appearing before us, rising from out of the depths of the ocean's bed in the form of great mountain ranges enclosing the basin of the present terrestrial sea, and that the inhabited portions of the earth for the most part therefore consist of a series of great elevated plateaux which crown the eminences around its shores.

The edges of these lofty plateaux—averaging 15,000 feet in height—therefore, are now lapped by the mighty waters of the ocean, which are continually beating upon its strand, and which fill the whole of this marvellous basin to its brim with that great liquid expanse which we call the sea.

The reader will please to kindly bear in mind that the mean depth of the ocean throughout what is known as its "Abyssal Region" is shown to be about 2500 fathoms *—or in other words, 15,000 feet,—and that the estimated area of this enormous region, submerged

* Introduction to the Scientific Report of the *Challenger* Expedition —summary of general conclusions, p. 49.

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not very far from three miles beneath the surface, is about 100 millions of square miles. * Now when we speak of the ocean, we must endeavour to regard it as one grand and continuous liquid expanse which extends around the whole terrestrial globe.

Beneath its waves, it is known to possess its submarine mountain ranges. When the tops of some of them come near the surface, they are then known as banks, or ledges of sunken rocks: in reality they form plateaux of these submarine ranges. The tops of others, which are higher, rise here and there above the surface of the waters, and are known to us as *islands*: these are merely the summits of submarine mountains upon which weather, but especially frosts and rains, acting during the course of ages, have levelled down many of the inequalities, and converted the surface into soil upon which vegetation has sprung up, leaving them in the condition in which they are now seen to exist. Large continental islands, on the other hand, such for instance as Australia, are probably created by the subsidence of areas of land which have sunk beneath the seas—leaving them remaining detached from the main land. The shallow nature of the present sea, studded with numerous islands, which lies to the northward of Australia, would appear to give colour to this theory: there are also many questions connected with the peculiarities of the flora and fauna, some of which are held to be evidence in support of it, whilst others appear rather to tell against it; but whichever way this may be, it is certain that this subsidence—if it occurred—took place at a very remote period of time;

* Introduction to the Scientific Report of the *Challenger* Expedition —summary of general conclusions, p. 46.

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and yet it remains a question whether this vast lapse of geological time would be sufficient to account for the differences which are found to exist between the plants and animals on the Australian continent and those of Asia—for variations are known to be *always* in progress, and therefore the longer the period that has elapsed since lands were thus separated from each other, the greater would be the probable divergence. Whole races of beings on one side for instance may become extinct, while on the other they may perhaps survive, but in a modified form. New species may also gradually be evolved—these however are speculations which are more properly dealt with in works specially devoted to the consideration of this class of subjects.

Leaving now the question of submarine mountains, and all similar considerations concerning which very little is really known beyond the mere fact of their existence, we approach the main subject matter of this section, namely the great terrestrial mountain ranges as they now exist in different parts of the world, rising above the general level of the surrounding land.

It would, we think, be unnecessary to enumerate a list of them: we propose therefore merely to refer to them in general terms, reserving certain sections of them for more particular notice hereafter, where that may appear to be desirable.

Let us begin with the mountains of America, as being much less complicated than the numerous ranges of the Eastern Hemisphere. A glance at the map shows that a vast range extends almost without a break, from the far north to the extreme south, right along the whole of the western sea-board of America. This

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we shall ask the reader to look at as a whole—and as constituting but a single great range, though local names have been assigned to various portions of it, such as the Rocky Mountains, and its parallel range the Cascade Mountains in Canada and the United States; further down in Mexico, it is called the "Sierra Madre" or Mother Range, * and still further down in South America the "Cordilleras de los Andes" or great chain of the Andes. Mountain ranges as a rule resemble very much in the general outline of their ground plan the vertebra of a fish—a herring bone in fact—the same sort of spurs or spines extending from the main ridge on each side, as we see in the case of a large fish bone. These spurs seem to occur on all great mountain ranges, and often extend out into the plains for very considerable distances. Most of the great chains also consist of two or more distinct ridges, running nearly parallel to each other, and indicating, if we might venture to hazard a guess on the subject, the existence of several lines of upheaval acting in the same general direction.

The Rocky Mountain system of North America for example, is supposed to be "the result of four specially marked upheavals; the first at the close of the carboniferous,—the second at the close of the trias,—the third at the close of the cretaceous,—and the fourth during the tertiary epoch," of which "the first and third were the most general in their effects;" †

* The word "*Sierra*" in Spanish, strictly translated means "a saw" from the supposed resemblance between the teeth of a saw and the jagged crests of the mountains.

† *The Origin of Mountain Ranges in relation to Geology and History etc.*, by T. Mellard Reade, C.E., 1886, pp. 47 and 48.

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and the Andes for the greater part of its extent—"consists of two parallel chains whose crests are separated by broad plateau-like valleys, from 20 to 60 miles wide, and from 8000 to 13,000 feet high. Near the northern termination there are three diverging chains instead of two, and near the southern there is but one. Numerous cross swells connect the ranges, separating the high valley into a number of distinct basins." *

It now seems to be regarded almost as a matter of ascertained fact that the great mountain chains of the world are the results of *upheavals* which have taken place from time to time from within the crust of the earth; and we think that this is susceptible of proof so clear, that it would be difficult to refute the truth of the proposition.

There is the incontrovertible fact, for instance, "that all the great mountain chains on the globe were originally part of the sea bottom;" † this is shown beyond the possibility of a doubt by the presence of numerous marine shells existing in the rocks of which the mountains are built up: such shells are found in the Alps "at heights of 10,000 feet or more over sea level." In the Rocky Mountains at "a height of 11,000 feet," and in the Himalayas "at 16,500 feet." § Moreover the rocks in which these fossil remains of the ancient sea are thus found are sedimentary rocks—that is to say, strata gradually formed during ages by the deposit of water. It is evident that this must

* *The Origin of Mountain Ranges in relation to Geology and History etc*, by T. Mellard Reade, C.E., 1886, p. 66.

† Extract from a Lecture on "*Mountain Architecture*" delivered by Professor Sir A. Geikie at the City Hall, Glasgow, 27th Jan. 1876, publ. 1877, p. 11.

§ *Ibid.*, p. 12.

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be so, because many of the shells, corals, algœ, etc., (all of which are of marine origin) are of an exceedingly delicate nature which a rude touch of any kind would have instantly destroyed; the conclusion is therefore irresistible that they were originally embedded in these strata, when they were in the state of soft mud, or ooze, which subsequently under compression, has hardened into rock. *Consequently*, these rocks must at some period of the earth's existence, have occupied a position at the bottom of the sea—*consequently*, the period of their deposit by the sea must have preceded the period when the mountains were upheaved —*consequently*, when the mountains were formed it must have been by the process of upheaval from below, and *not* by subsidence from above—*consequently*, also, this must have occurred at a comparatively recent period of geological time, as the sedimentary strata are known to be among the last which have been deposited in point of geological time.

These results, as we humbly venture to suggest, seem to follow almost as a matter of mathematical certainty—indeed the traces of upheaval are often clearly borne upon the face of the rocks themselves; for they are found to be contorted, twisted, and folded over upon each other, or upon themselves, exactly like the leaves of a book that has been forcibly bent.

An examination of the plates, given in almost any geological work, of the contortions assumed by these rocks, will clearly show that this is so;* but when we proceed to seek for the causes of these mighty

* See for instance the plates in Mellard Reade's book on *The Origin of Mountain Ranges;* see also Sir Charles Lyell's *Elements of Geology*, 1865, fig. 65, p. 50.

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upheavals, we are then more or less enveloped in the domain of speculation.

How did the great event come to pass? We venture to suggest that mountain ranges are simply ridges, or creases, formed upon the earth's surface by compression, and shrinkage occurring in its crust, as its exterior surface cooled. Shrinkage caused a crack, or fissure to form; while compression caused plutonic rocks, existing in a molten condition within the earth's surface, to extrude, and these rising in a soft but not in a fluid state, through the fissure, formed the heart, or core, of the mountains—and this is exactly what is found to occur in the structural formation of all great mountain ranges: the granites and other crystalline rocks form the *central* and *higher* portions of the ridges: that is to say the mountain peaks—while the sedimentary, or fossil bearing rocks, through which they have been forced, form the exterior sides, and bases—the slopes of the hills in fact.

We must here explain that the plutonic rocks (to which allusion is made above) differ from the volcanic rocks, in that the latter always seem to overflow in a fluid state, like lava from volcanoes, and are generally therefore found to be overlying the newer rocks through which they have been ejected; whereas the plutonic rocks (comprehending all the granites, certain porphyries, and the crystalline schists) rarely or never do so. * It seems probable therefore that they are forced up from below by compression, in a soft or plastic state; they thus rise up aloft and form mountain peaks, but do not overflow, like lava. Moreover, though

* See passages in the *Elements of Geology*, by Sir Charles Lyell, pp. 7 and 8.

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volcanoes have been in constant action since the dawn of history, and long before it, yet the elevation of hills by their agency has always been a very slow and partial process. The history of the best known volcanoes is decisive as to this. Therefore as a factor in the creation of mountain ranges, their action may be regarded almost as infinitesimal. Moreover so far as is known, except in the case of a certain number of peaks in the Andes and some few others, very few of the highest mountains have ever been volcanoes, also the high ridges and peaks of the majority of mountain ranges are very generally known to consist of the plutonic, and not of volcanic rocks.

Now at the time when these rocks burst through the overlying sedimentary strata, in the way described, the edges of the latter were forcibly bent up on each side of the gap, so as to form, as they do now, the exterior and lower slopes of the mountains, which rest upon the core of older crystalline rocks, thus forced up through them; and so, as we humbly venture to suggest, the great systems of mountain ranges upon our earth were originally built up.

It is however true that instances may be cited where the older sedimentary rocks are found occasionally occupying positions on the tops of mountains, and the interpretation we should be inclined to put upon that fact is, that these rocks were in such cases simply bulged up by the force from below, which would seem at that point to have lacked sufficient power to burst through, and so therefore did not pierce the superincumbent mass. In other cases where an enormous display of force seems to have manifested itself, and where in consequence the upheaval of two or more

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parallel ridges seems to have taken place simultaneously, considerable areas of these sedimentary rocks are often found to have been entirely separated from the rest of these strata, and carried up so as to occupy the floors of the valleys or high plateaux which in such cases are generally found to fill the spaces between the ridges. Magnificent examples of these elevated plateaux are to be found in Thibet, where they extend for hundreds of miles, at an altitude averaging say about 16,500 feet above the level of the sea. Other instances, second only to those of Thibet, are to be found in the Peruvian and Bolivian Andes, where vast table lands exist, ranging from 11,000 to 14,000 feet above sea level, surrounded by some of the grandest mountain scenery to be found in the world.*

In the case of adjacent and parallel chains of mountains, of which there are such numerous instances, the question will naturally arise—was the upheaval of these several chains *simultaneous?*—or did it occur at different periods of time? Of course the reply must be to a great extent conjectural; nevertheless, careful scientific observers have come to the conclusion that the balance of probabilities appears to require an affirmative answer. In the case of the Alps, a chain of mountains which has been the subject of much more general and careful study than any other, the evidence in support of the hypothesis of simultaneous upheaval seems very strong.

"The broad fact (says Dr. Ball) that the same sedimentary deposits, varying very little in mineral character, extend

* See paper by Colonel Trotter, R.E., giving an account of the journey of the Pundit Nain Sing in Great Thibet from Leh in Ladakh to Llasa; in Journal of Royal Geographical Society, Vol. 47, p. 9.

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over very considerable spaces on the same side of the mountain chain and are often found in the troughs separating parallel groups, offers a strong argument in favour of the belief that the process of upheaval, proceeded simultaneously, if not along the entire line, at least over a very wide area." *

And again he proceeds to point out—

"When we find the same sedimentary rocks lying in the same order and superposition on the outer slopes of the parallel ridges, and in the trough between them (a relation which holds good to a great extent in a section taken from the Val Ferrex across the range of Mont Blanc and the Aiguilles Rouges), we are entitled to infer the cotemporaneous elevation of both ridges." †

Dr. Ball then goes on to show that there are several portions of the Alps where this same thing occurs, and where a similar method of reasoning leads the mind to a like conclusion, and he quotes a notable instance where it is found that

"the stratified rocks on the opposite sides of the 'Belledonne' group are so similar in their composition and arrangement, as to lead to the inference that they must, at one period, have formed portions of a continuous mass," §

indeed surveys in some cases seem to show that strata thus divided by the extrusion of a mountain chain, would fit back into their places almost exactly, if the mountains were quietly lowered beneath the earth's surface.

We thus see that the vast preponderance of evidence is all in favour of the hypothesis of the upheaval of mountain ranges by matter forced up from below

* *The Alpine Guide* (to Central Alps), by John Ball, F.R.S., page xciii of Introduction.

† *Ibid.*, p. xciii of Introduction.

§ *Ibid.*, p. xciii of Introduction.

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which pierces through the superincumbent strata, and in so doing, flexes them into various shapes upon its external slopes: and that the probabilities also are that each of the great mountain chains of the world is created by a more or less simultaneous movement of the earth along the main axis of its elevation.

The vastness of this operation may cause the minds of some to stagger at the contemplation of it, but it must be borne in mind how small is the proportion which even the mightiest mountain range bears to the whole bulk of the globe. Thus according to Herschel "the earth contains 259,373 millions of cubic miles" of matter, * and the bulk of what is known as the crust of the earth is estimated by Mr. Mellard Reade, C.E., as equal to only about $\frac{1}{51,875}$ part of that of the whole globe. The crust of the earth has thus aptly been described as bearing a proportion to the earth itself somewhat as the rind of an orange does to the entire fruit; and the proportion borne by mountains, compared with the earth's crust is so minute that Sir John Herschel likens it

"to the roughness on the rind of an orange, compared with its general mass. The comparison (he states) is quite free from exaggeration, because the highest known mountain hardly exceeds 5 miles in perpendicular height. This (Sir John Herschel points out) is only one 1600th part of the earth's diameter, consequently on a globe 16 inches in diameter such a mountain would be represented by a protuberance of no more than one hundredth part of an inch, which is about the thickness of ordinary drawing paper." †

* *Outlines of Astronomy*, by Sir John Herschel, New Edition of 1881, p. 560.

† *Ibid.*, p. 23.

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Hitherto we have confined our observations to the aspect of mountains in their structural capacity; we now propose to take a brief survey of their history, subsequent to their upheaval.

Mountains have usually been regarded as the very types of antiquity, solidity, and everlasting endurance: so that the expressions "as old as the hills," or "immovable as the mountains," have become proverbial. Nevertheless scientific observation teaches us that it is necessary to regard such phrases merely as so many figures of speech; for in very truth, from the moment of their upheaval the process of disintegration began and has ever since been going on without intermission, and it is easy to show that the law of change has constantly operated upon them, not one whit less remorselessly than it has done and is doing, upon everything that exists on earth; thus, time "that turneth all to dust" is slowly but not the less surely wearing away the everlasting hills, till eventually it will again reduce them to the level of the plain.

The process by which this is being effected is known as *Denudation.*

"You may deem a well known mountain form (says Professor Geikie) perfect and well nigh eternal. Perfect it may be, in the majesty of its mass, and the symmetry of its sweeping lines;—but eternal! no. Climb its sides; and you find proof on every hand that the great World-Sculptor is not done with it; and that in spite of its look of placid rest, it receives a fresh chiselling every year." *

The operations of Nature, the Professor proceeds to

* *Mountain Architecture*, a Lecture delivered in the City Hall, Glasgow, by Professor Sir Archibald Geikie, 27th January 1876. Published 1877, p. 19.

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point out, are in this respect "continuous, nor have we reason to suppose that they differ materially from age to age." * Then he goes on to pass in review four of the principal agencies which are thus at work, namely—(1) Ice wedges. (2) Snow and glaciers. (3) Rain, and (4) Rivers. We shall however at present content ourselves with merely glancing at the operation of the first of these—the ice wedges. Water lodges in the joints of the rocks and there freezes.

"In freezing it expands and tends to push the walls of the joints apart. If by chance a thaw should come, followed by a return of the frost, a further expansion would take place. This process repeated many times goes on season after season: until at last the cohesion of the mass is destroyed, and down goes a thundering heap of ruin to the base of the cliff. Thousands of tons of rock are thus dislodged from the sides of the higher mountains, and sent to strew the slopes all along the bottoms of the valleys." †

The reader will thus see the enormous influence of that one single agency in reducing the grandest mountain peaks to a heap of ruins; the stupendous power of expansion exercised by water in turning to ice is something almost incredible. In practice there is nothing that can resist it. Water, as we know, attains its greatest density at 39.2° Fahr., after which it slowly expands, until a temperature of 32° F. is reached, at which point congelation takes place; and in freezing—"it suddenly expands about one-eleventh of its bulk, with almost irresistible power; and a pressure as high as 28,000 lbs. to the square inch

* *Mountain Architecture*, a Lecture delivered in the City Hall, Glasgow, by Professor Sir Archibald Geikie, 27th January 1876. Published 1877, p. 19.

† Professor Sir A. Geikie in *Ibid.*, p. 20.

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has been estimated as having been produced by it." *

Every time therefore, that the water freezes in the crevices of the rocks, this mighty force is at work, and tends bit by bit to dislodge them from their places, so that in the end disruption is certain; and a mass of ruins, as Professor Geikie has pointed out, is precipitated into the plains below; in consequence a ramp of debris is always found occupying the base of cliffs and rocky slopes, and roads constructed across high passes are also more or less obstructed in this way every winter by falls of stone and gravel, occasioning great expense in clearing and keeping them open.

The action of rains in causing slides of earth, clay, and even rock, is well known to everyone, and the late serious disaster to the village of Sandgate near Folkestone in Kent, is merely another example of a land slide on a more than usually extensive scale. †

The subsidence of the Undercliff in the southern part of the Isle of Wight furnishes a further instance of vastly greater proportions, but this event is of ancient date, and is supposed to have been aided by the action of the sea operating upon the soft clays underlying the chalk and greensand in that locality. These instances of extensive earth slides are however, as we know, comparatively rare, whereas the slower processes of denudation are *always* in operation, and in one form or another, it may be accepted as certain that these forces of Nature are unceasingly at work, grinding and wearing away the hills, and filling up the valleys; and so reducing to a level the various

* *Scientific American* of July 6, 1889.

† This event occurred on the night of March 4, 1893, after a period of heavy rains—more than 200 houses were wholly or partly destroyed.

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inequalities with which the earth's surface is studded. Hence it appears to follow that the great mountain chains of the world were in all probability, originally much higher and more abrupt in their slopes than they are at present, as the constant falls of material must, in the course of ages, have caused considerable alterations to have taken place in their contours. This wearing away of the higher peaks has also of course tended to fill the valleys with a level floor of detritus covered with deep alluvial soils, such as we find so often to exist between the spurs and parallel ranges of mountain chains—large quantities of these materials again, have been carried down into the plains, in the form of gravel, sand and mud, by the streams which are generally found to occupy the beds of nearly all extensive valleys and ravines.

Consequently the foot-hills extending along the bases of great mountain ranges are always found to consist of long slopes formed of deposits of such materials. In many places such foot-hills are covered with luxuriant forest growths. Lands of this kind, in their natural state, possess great fertility, on account of the depth and richness of the soil washed down upon them from the hill sides above. Consequently therefore, inasmuch as great wealth of vegetation always goes hand in hand with the existence of malaria, in tropical regions, these localities are in most cases hotbeds of pernicious fevers of malarial type in warm climates, and some of the most deadly neighbourhoods in the world occur under such conditions. The wide district known as the "Terai" will probably present itself to the minds of our Indian friends, as a striking instance in point.

The Terai (including the Bhábar) is a belt of fertile

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forest and swamp land, answering exactly to this description, extending along the southern base of the eastern part of the great Himalayan range for a distance of some 90 miles and varying from 20 to 25 miles in breadth; the superficial area of the whole may be roughly estimated at about 2000 square miles. This region which is usually spoken of generally as "The Terai," in reality consists of two distinct belts. The forest belt which lies close to the mountain foot is known as the Bhábar. Here the water for the most part disappears below the surface and filters through the gravels beneath it, as far as the edge of the Terai proper, or swamp belt, where it bursts forth in a series of springs which inundate the land and form successions of pools and swamps which are in most cases surrounded by high reeds and grasses. Finally the surplus waters flow away in streams, to join the rivers of the plain. From its known highly malarious character, the Terai is for the most part abandoned to a state of Nature, it therefore forms the resort of most of the larger and more wary kinds of Indian game, which makes this district one of the best hunting countries in Hindustan, where excellent sport may still be obtained by the adventurous sportsman. To attempt to hunt there however in the sickly season, would of course be madness; but in the hot weather towards the conclusion of the dry season fevers are much less rife than at other times. This latter period is therefore the time selected by sportsmen for their excursions.

Lovers of wild scenery visiting the Terai will be charmed with the richness and beauty of the vegetation of the forest belt, where every now and again superb vistas of the mighty Himalayan range may be enjoyed,

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at openings on the edges of ravines and other places which afford advantageous standpoints for obtaining good views.

Of the Indian plain itself which skirts the southern edge of the Terai, in this chapter on great mountain ranges, we need say but little, except this: that when we come to regard this latter immense territory, as we shall have to do in our next chapter, as a region formed in some way by the deposit of water, grave questions arise as to where all the material came from to level off this enormous region, seeing that the great plain of Northern India extends in an almost unbroken surface across the whole of Northern Hindustan. Its apparently absolutely flat character has thus far proved somewhat of a geological puzzle to account for. It looks as if it must have been deposited by the sea, and yet, as we hope to show hereafter, this is highly improbable. That being so, and if we reject that hypothesis, some other agency must be sought for to explain, if that be possible, how this gigantic area was levelled and brought into its present flat and ocean like condition. Careful examination of the land shows that it consists of a vast "alluvial deposit of sandy clay, on the surface of which nothing in the shape of a pebble can be found, except in the immediate vicinity of the hills." * The stones, as we here see, remain near the mountains' foot and the lighter stuff goes to form the plain. From whence then were these enormous, incalculable amounts of alluvial detritus derived, spread over 500,000 square miles of superficial area? Can it be that at some distant epoch, other great mountain chains may have been in existence, which time, fretting like a moth

* *Encycl. Brit.*, 9th Edit., Vol. xi, p. 827 (Article "Himalaya").

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throughout the lapse of ages, has gradually ground down into dust by means of agencies such as we have already hinted at: so that the only trace that they once existed is now furnished by the mass of detritus which has been spread out, as butter is spread over bread, to form the surface of the great plain of Northern India?

It is more than probable.—Without going so far as to assert that this was so, we believe that this hypothesis would to a great extent explain the source from whence all this material was derived. The whole question is however one of probability and circumstantial evidence, and this, we humbly venture to suggest may furnish a clue to its solution. But if so, what a marvellous idea does it exhibit of the enormous antiquity of the earth.

Let the intelligent reader try to picture to himself if he can, the immense periods of time which this process must have taken to carry out. What shall we say? Does it represent epochs extending over millions of years? If so how many millions? Was it tens, or was it hundreds, of millions? In the contemplation of the phenomena of Nature, the student constantly finds himself met by these and other similarly perplexing problems, respecting the vastness of geological time, and the mighty changes which the features of the landscape that at present meets our gaze must have undergone during the lapse of an eternal past.

It may be answered that such events of incalculable magnitude extending over epochs of such enormous durations are inconceivable and impossible!

Why should we deem them to be so? If we compare the proportion of even the greatest mountain

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range with that of the terrestrial globe, how small a thing does it appear! It is merely, as we have said, like the roughness on the rind of an orange, when compared to that of the fruit itself. * A mere abrasion, so to speak, rubs it off.

And again it has been estimated by Humboldt that if the whole of the mountains now existing in Asia were reduced to powder and spread evenly over its surface, it would not add more than 150 feet to the general level of that continent. † Yet we know that not only in Asia, but also generally over the whole surface of the terrestrial globe, change has succeeded change: and deposits which incontestably were created by the deposit of still water, such as the ocean or some mighty lake, have been formed extending over enormous areas which represent not merely 150 feet, but many thousands of feet in thickness. From whence did the materials to form *these* proceed, if not from detritus carried down by the action of natural forces from higher levels.

Now in considering the probable age of existing mountain ranges; the whole of those considerations crop up before us afresh; and we can have little doubt that though existing mountain ranges are of vast antiquity, in an historical sense, yet they are new in a geological sense. This is proved by the fact of their bursting through those numerous series of stratified rocks of modern foundation which were (as the fossil remains in them show) created by the deposits of water. For this purpose it matters not whether the mountains are

* See observations on this point in *Outlines of Astronomy*, by Sir John Herschel. Edition of 1881, p. 23.

† See *Advanced Text Book of Physical Geography*, by David Page, 3rd Edition, 1883, p. 71.

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regarded as the creation of a single mighty convulsive throe of Nature, or whether they are supposed to have been gradually pushed up by forces working from beneath to their present height. The fact that they *have* forced their way up through these overlying strata is unquestionable. Personally however, we think the balance of probabilities leads strongly to the supposition that each of the great mountain ranges of the world were the result of some vast and simultaneous extrusion of matter along their chains, which has taken place comparatively recently from a geological point of view: and that this upheaval would seem to be the work of a single operation and not that of a number of desultory efforts spread over long periods of time. It is this latter hypothesis alone which we are desirous of combating, and we shall proceed to give reasons for this our belief.

A reference to the map will show that the main ridges of the great mountain chains of the world are drawn in more or less continuous lines. It is true that there are frequently several distinct ridges, forming parts of the same chain, but if so, they are almost always drawn parallel to each other, indicating that the forces of upheaval were uniformly acting in the same direction. These facts seem to us to furnish a very strong argument in favour of the supposition that the whole movement was a simultaneous one, and *not* a series of detached movements made at different times. Had these great ranges been constructed bit by bit, at various epochs, this striking regularity of form could hardly have occurred by chance, repeated as it is in all of the principal mountain ranges on each of the great continents. Then there is this peculiar

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fact to which we have already drawn attention, of areas of the sedimentary rocks being bodily carried up into the valleys, between the principal ridges, and left lying there in the same order in which they exist beneath the plain; and we agree with Mr. Ball in regarding this as strong evidence of the simultaneous upheaval of *both* ridges—furthermore these sedimentary rocks being of the tertiary period in most cases, it follows that their elevation is of more recent date than they are. Thus in the opinion of the superintendent of the geological survey of India, and other officers of that department, the Himalayas are "generally supposed to have been upraised in late tertiary times." * The *Encyclopædia Britannica* takes the same view. †

In closing this brief survey of the probable origin of mountains, a few words as to their vast antiquity from the point of view of *historical* time may be desirable. Modern though they certainly are, when compared with the mighty epochs represented by geological time, we venture to assert that their watercourses supply ample evidence to establish the great antiquity of existing mountain ranges: for a ridge once formed upon the earth's surface will remain the watershed of the surrounding country for untold ages; and no observant man can have examined the gorges issuing from a great mountain range, cut as they frequently are for hundreds of feet perpendicularly through the living rock, without being impressed with the vast periods of time which the water must have taken to wear away such conduits.

* *Manual of the Geology of India*, compiled from the Observations of the Indian Surveys, by order of the Government of India, by H. B. Medlicott, superintendent, and W. T. Blandford, F.R.S., published Calcutta 1875, Part II, chap. xxii, p. 520.

† See *Encyclopædia Britannica*, 9th Edition, Vol. xi., p. 828.

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"The land may increase or diminish in area; river systems may be flexed; but the strong ridge drawn across a continent by a mountain range, will remain through all these revolutions of time a great divide that the rivers cannot pass. Rivers frequently run parallel with, or between mountain ridges and ranges for long distances; and then break through them, but rarely or never bisect them." *

Notable instances of such rivers are to be found in the Himalayan system, as a glance at the map at once shows, and it may be that though these great mountains may have been upraised in late tertiary times, still it seems probable hundreds of thousands, it may even be millions of years have come and gone, since these mighty ranges of snow-clad peaks assumed their present aspect in all its leading features.

Leaving now the question of the origin of mountain ranges, let us briefly consider them in their aspect as factors in the regulation of climates. When we consider how small a thing they are in comparison with the earth itself, their influence in this respect is very much more considerable than might otherwise have been expected.

It is generally supposed that an increase in elevation of about 300 feet is sufficient to produce a fall in the temperature of about one degree Fahrenheit—one thousand feet would therefore represent something more than 3 degrees. Viewed in this light, it must be obvious that a lofty mountain range in the equatorial regions will represent every variety of temperature existing from the equator to the pole. The line of perpetual snow may be fixed in tropical regions at an altitude

* *The Origin of Mountain Ranges*, by T. Mellard Reade, C.E., 1886, pp. 306—7.

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somewhere about 16,000 feet over sea level; but this is liable to be modified by local causes—that is to say it rarely comes down much lower than that, but owing to the set of the prevalent winds and the aspect of the mountain slopes, it is sometimes pushed considerably higher up, say to 17,000 or even 18,000 feet. Thus on the Bolivian Andes the line of perpetual snow has been fixed at 16,000 feet. * The mean result of Humboldt's observations made in the equatorial regions of South America a century ago, gave almost similar results. He fixed it then at 15,748 feet. Furthermore on the Himalayas, the Indian surveys show that on their southern face the snow line ranges from 15,000 to 16,000 feet. This is mainly due to the influence of the winds that come up from the plains, charged with moisture, which is here precipitated in the form of snow; they then pass northwards, as dry cold air, mainly deprived of their moisture; with the result that on the higher plateaux of the Indian watershed, the altitude of the snow line rises to 18,500 feet, while on the great table-land of Thibet on their northern or reverse face it reaches about 20,000 feet. † This affords us an admirable instance of the immense influence which high mountains always exert upon climate. At these great altitudes rain very generally falls in the form of snow. When the monsoons burst in torrents of rain upon the great plain of Northern India therefore, the water falling upon the higher Himalayas, does so as snow —and the intensity of the cold created by the upcast of the aereal currents into the higher regions of the

* See Stanford's *Compendium of Geography and Travel for Central and South America*, edited by H. W. Bates, 1878, p. 207.

† See *Encycl. Brit.*, 9th Edition, Vol. xi, p 831 (Article "Himalaya").

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atmosphere, as the winds flow over the summits of the snowy range—wrings them so completely dry of moisture that the snow-fall is very much less upon the northern slopes of the Himalayas than it is upon their southern face.

But it is perhaps in South America where this may be witnessed in the most striking form of all. To the eastward of the Cordilleras the climate is for the most part of an exceedingly damp and rainy character, and the luxuriance of the tropical forest growth upon their eastern slopes is therefore correspondingly conspicuous, yet the winds in crossing the snow-clad heights so completely lose their water-bearing capacity, that almost no rain falls to the westward and much of the country in Peru, Bolivia, and Northern Chili, is in consequence perishing for want of water. It is in fact impossible to conceive two countries more essentially different in appearance and climate than those lying in the same parallel of latitude, to the eastward, and to the westward, of the Andes. At Lima, the capital of Peru, for instance, though if we mistake not we once saw a shower fall there, it is said that, scarcely a drop of rain ever falls, though there is now and then a strong dew, as may be perceived of a morning by the still moist roofs.

Nearly the whole of the plains country in Peru is subject to these extraordinary droughts, and constitutes what may almost be termed a rainless district. "Long intervals of time succeed each other without a single drop of rain falling on the thirsty soil, and showers are as rare phenomena as the appearance of a comet, or an earthquake." *

Bolivia, the adjoining republic to the southwards, is even still more afflicted by drought, and a great deal

* Stanford's *Compendium of Geography and Travel in Central and South America*. Edited by H. W. Bates, 1878, p. 269.

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of that country is an absolute waterless desert. The desert of Atacama, a wide district, rainless, herbless, and hopeless, forms a portion of Bolivia where, though as in all deserts, torrential rains do sometimes fall, still it is said to be a fact that such an event does not occur more than once in every 20 years, or perhaps in every 50 years; * and yet in the "Hinterland," that is to say the region behind these countries on the other side of the mountains eastwards of the Andes, forests of surpassing luxuriance, and well-watered lands of very great fertility, exist almost everywhere. Comparatively little is however known of this country (generally spoken of as the region of "*La Montaña*") which is cut off from communications with the Atlantic seaboard by the wide extent of the Brazilian dominions which intervene between it and the sea, a great deal of which are still a terra incognita; while to the westward the mighty range of the Cordilleras blocks the way quite as completely, and is only to be crossed by means of very elevated passes, practicable merely for pack animals, where little or nothing has been done in the way of constructing permanent roadways; nevertheless enough is known to show the generally extremely fertile character of the country eastward of the Andes, a great part of which is covered with forests, whose productions, so far as they have been explored, appear to be second to none other on earth. It was from these forests for instance, that the far-famed Peruvian bark (*Cinchona Calisaya*), that inestimable boon to humanity, was obtained, and is still to be found growing wild in great abundance—

* Stanford's *Compendium of Geography and Travel in Central and South America*. Edited by H. W. Bates, 1878, p. 199.

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together with many other valuable products of different kinds. This trans-Andean province of Peru there can be little doubt will one day assume its proper place, as the most valuable of all the possessions of the Peruvian Republic. It is here too that the head waters of the great river Amazon (called the Marañon by the Peruvians) take their rise, and flow almost uninterruptedly by navigable channels to the Atlantic.

In our section on the great river systems of the world we hope to be able to furnish more specific details as to these South American rivers; a glance at the map is however sufficient to show the vastly more numerous and more important nature of the streams that issue from the Andes, on their eastern watershed, when compared with those that do so on the other side.

With the exception of the river Guayes in Ecuador, which is navigable for 70 or 80 miles and falls into the sea at Guayaquil—there is no other river of importance which reaches the ocean upon the Pacific seaboard of South America; many of the other streams flow westward for a certain distance from the mountains, and then become dried up, and lost in the plains; while others merely reach the sea, in the dry season, as insignificant rivulets. At many of the sea ports on the western coast (such is the intensity of the drought) the principal building in the town consists of the *Water Factory*, or place where the supply of drinking water is distilled from the sea, and sold to the inhabitants for their daily consumption.

This remarkable state of things may, as we venture to believe, be set down entirely to the influence exercised by the great range of the Andes upon the climate of South America, where the prevailing set of the winds

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is from the eastward, and these mountains, as we have already explained, cause the precipitation of vapour carried by trade winds in invisible and impalpable form from the Atlantic ocean, to take place almost entirely on their opposite or eastern slopes, and so the desiccation of the western seaboard is brought about.

"Although (says the *Encyclopædia Britannica* in its article upon the Himalayas) the loftiest mountains when compared with the earth's diameter are insignificant; and the irregularities of surface would hardly be perceptible on any sphere however large, that could be made to represent the earth; yet heights such as those reached by the Himalayas, introduce modifications of climate that are not surpassed by those observed in moving from the equator to the poles. One half of the total mass of the atmosphere, and three quarters of the water suspended in it, lie below their average elevation; and of the residue, one half the air, and virtually almost all the vapour, come within the influence of the highest peaks." *

The truth of this hypothesis is beautifully illustrated by the condition of the Pacific seaboard of South America, and it is hardly too much to say that it renders the meteorology of the Andes region perhaps the most remarkable and instructive of any other in the world.

And not only does this mountain range exercise this commanding influence upon the rainfall of the country, but it also, by reason of its great elevation, creates upon its slopes a range of climate which embraces every possible variation of temperature. The principal part of this range passes directly through the whole breadth of the southern tropical regions and also extends through a considerable portion of those lying to the northward of the equator—so that it

* *Encycl. Brit.*, 9th Edition, Vol. xi, p. 829 (Article "Himalaya").

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affords in this respect incomparably the best conditions for the study of the geographical range of plants as influenced by altitude—but it is to be feared that there is yet a great deal to be said and done before the flora of the Andes can be considered to have been exhaustively investigated. A good deal of their western slopes in Peru and Chili are of a very barren character, consisting in many places of vast ranges of volcanic sand and gravels which appear when viewed in the distance to be wholly devoid of vegetation; on a nearer approach however, this illusion is dispelled by finding considerable areas dotted over with grasses and many kinds of plants; while in ravines along the course of streams dwarf trees and bush ascend to considerable elevations, but it is on the eastern side almost exclusively that luxuriant growths are common. Towards the northern part of the continent however, from Panama downwards to the southern limits of Ecuador in the region of the equatorial rains, the country is generally covered with forest on both sides of the mountains, and presents a rich and varied appearance. To form an idea of the wealth of the tropical vegetation of this region, a splendid excursion may be made from Guayaquil to Quito, a distance of about 160 miles, which in our day had to be performed on horseback, and took some eight or ten days to do. The road leads mostly through the forest, along the slopes of the Chimborazo, a volcano 21,424 feet in height. * The scenery is magnificent, and the traveller passes through every variation of climate, from the sweltering heat of Guayaquil to the city of Quito, situated at an altitude

* *Encycl. Brit.*, Vol. ii, p. 17 (Art. "Andes").

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of 9520 feet above the level of the sea, * where the mean annual temperature is only 55° Fahr., though the Equator is supposed to pass as nearly as possible through the town—or a very little to the north of it as some say.

Here, in the close proximity to the snow-clad peaks, the traveller may enjoy the climate of an English spring, under a sky of matchless purity. From Quito trails lead quickly down from the tableland to the zone of tropical heats; and the fruit markets, for which the town is celebrated, are well supplied not only with all the best fruits of the temperate zone, but also the finest varieties of tropical growth, in great profusion. Quito is thus specially referred to, as furnishing a striking example of the all-powerful influence exercised by mountains upon climate; for here, in this zone of highest normal temperatures, it thus becomes possible for the visitor to enjoy any range of heat or cold that he may desire. He may live at Guayaquil in a torrid climate, where the mean temperature of the year is as high as almost anywhere on earth, or he may ascend to Quito, where exactly upon the equator, it is that of the colder temperate zone, or still higher, where he at length enters into the region of perpetual snow.

The rapid change from the evergreen equatorial zone to the desert, is singularly striking in South America, as almost immediately we leave the southern limits of the region of continuous rains, the dry plains begin. The cause of this, it can hardly be doubtful, is entirely due to the influence of the mountains, whose great altitudes have as we have stated, intercepted

* *Encycl. Brit.*, Vol. xx, p. 189 (Art. "Quito").

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and condensed the vapours with which the trade winds are charged. Were it not for the accumulations of snow collected upon the mountain tops, it may be very safely assumed that a great deal of the western coast would quickly be converted into uninhabitable desert: for the plains of Peru and Bolivia, which lie to the westward of the Andes, are watered almost exclusively by the streams issuing from their gorges, which are fed by the melting snows.

By their agency, considerable areas lying between the western spurs of the mountains, are irrigated; here luxuriant forests spring from the deep and fertile soil, which however are of distinctly malarious character. This occurrence of highly malarious districts, extending along the foot-hills of mountain ranges, seems to be general everywhere in countries where warm sunshine is prevalent.

Malarial fevers of a serious nature are therefore a thing which a traveller should always anticipate, and be on his guard against, when approaching such localities.

Once the rivers pass out into the plains however, fertility is mostly restricted to a narrow belt of alluvial land, bordering upon their banks, while the remainder of the country but too often presents an exceedingly barren appearance.

"The districts between the river valleys," says the *Encyclopædia Britannica* in its article on Peru, "vary in extent, the largest being upwards of 70 miles across. On their western margin steep cliffs generally rise from the sea, above which is the 'Tablazo' or plateau, the whole appearing quite bare of vegetation." *

* *Encycl. Brit.*, 9th Edition, Vol. xviii, p. 760 (Article "Peru").

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Upon these plains rain falls only at rare and uncertain intervals, and the vegetation visible during the continuance of dry weather, consists only of a few herbs, which withstand these long periods of drought, being kept alive by long tap roots, which penetrate deeply into the subsoil—the only thing in the way of tree life which is able to maintain existence is the desert Algarrobo (*Prosopsis Horrida*), a dwarf tree of lowly growth, and two others, both mere shrubs.* The dry season generally lasts from November to April. Some districts are however refreshed by heavy dews, which serve to promote the growth of a coarse herbage and prevent the entire desiccation of the land. From June to September also, fogs proceeding from the Pacific, sometimes accompanied by fine rain, create a short yet beautiful period of growth and verdure, showing that here (as in most so-called deserts) it is the want of water alone which produces sterility. This mist and drizzling rain is known by the natives as "La Garua," and as soon as it sets in "a blooming vegetation of wild flowers for a short time covers the barren hills," where in general "the deserts present no sign of a living creature, or of vegetation." †

Cultivation is as we have said, confined to the neighbourhood of the rivers, whose courses are generally indicated upon the landscape by lines of fine trees, palms, willows, poplars, etc., and by means of irrigation channels beautiful gardens and fields of crops occasionally appear, like a verdant carpet spread forth upon the thirsty soil. This dry coast region as it is called in

* *Encycl. Brit.*, 9th Edition, p. 670.
† *Ibid.*, Vol. xviii, p. 670 (Article "Peru").

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Peru extends from the shores of the Pacific to the foot-hills of the Cordilleras and varies in width from 40 and 50 to nearly 100 miles. Here it is succeeded by the "Sierra" * or Mountain Region, which is about 250 miles in width beyond that again. Eastwards of the mountains is "La Montaña" of which we have already spoken. Such are the three divisions into which the Republic of Peru is longitudinally divided.

Surely it would be difficult to conceive three regions more essentially different in all their characteristics. Yet all of them are lying in the same parallels of latitude, and equally partake of the prolific influences of the tropical sun. Facts such as these however, are needed to teach us the paramount nature of the control which the neighbourhood of a lofty mountain range exercises over climate.

The country is sharply divided from north to south by the great Andes chain, as if by an impassable gulf. To the east of them lies one of the dampest and rainiest climates in the world, where everything is dripping with moisture. Here vast navigable rivers take their rise; and winding their way through what is probably the greatest and densest tropical forest in the world, discharge themselves, after a course of several thousand miles, by the great Amazon system into the Atlantic ocean.

To the westward of them lies a parched and thirsty land—a country suffering for the greater part of every year under almost complete drought. The sparseness of inhabitants compared with the wide extent of territory however, prevents the results which would naturally

* Literally in Spanish a "saw," from the likeness born by the jagged peaks of "La Sierra" to the teeth of a saw.

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have followed prolonged droughts in a thickly populated district; as for instance on the plains of Hindustan, where drought may be regarded as synonymous with famine.

Indian droughts as we have elsewhere shown are often followed by the most terrible consequences. We find, however, on our north western frontier there, an extensive mountain state which as regards its rainfall seems in all respects, except one essential particular, to be the counterpart of the climate of Peru. We refer to the hill state of Kashmir (or Cashmere as it is often written)—and the one essential difference between Kashmir and Peru is that the great Himalayan range here intercepts the masses of vapour carried by the winds from distant seas across the burning plains of India, and causes them to be deposited in the form of immense masses of snow upon their southern face.

Mighty rivers therefore here take their rise, and traversing the state and dependencies of Kashmir, roll down from thence to the sea—the Indus, the Jhelum and other great rivers for example. Thus while the Indian plains may be perishing with drought, unless where they are protected by irrigation canals drawing their supplies of water from these rivers, Kashmir may be enjoying the blessings of special fertility, the watercourses there being constantly maintained full of water during the dry season, by the melting of the snows. Kashmir therefore is thus rendered independent of rain—all that is in consequence required to ensure an abundant harvest, is that the previous winter should have been hard enough to store up a sufficiency of snow upon the mountain tops to furnish the summer water supply.

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Kashmir, we may add, has an irregular and uncertain rainy season of its own, but the rainfall is often insignificant and in general does not come at the right time of year to supply the moisture necessary to perfect the growth of crops. Thus it happens that "every great famine that has occurred in Kashmir has been caused not by the summer droughts, but by a too mild winter, or by heavy rains in the hot season, which have flooded the plains and destroyed the crops." *

Nevertheless, owing to the copious irrigation afforded during the hot weather by the snow streams, the valley of Kashmir may be described in general terms as "a green land of woods and pastures." † But the moment the lofty snowy ridge, which divides Kashmir from Ladak and other mountain states to the northward and eastward is traversed; the traveller is met with the same remarkable contrast that is observed in Peru. This great divide has not failed to intercept and condense the atmospheric vapours; and in consequence "on crossing the Zoji La pass (13,400 feet over sea-level) one suddenly enters the great black wastes of Central Asia, where there is practically no rainfall, and where even the winter snowfall on the mountain tops, is light," § because the snow has fallen almost entirely on the opposite side of the ridge; the climate of Ladak therefore, says the *Encyclopædia Britannica*,

"is intensely dry, and practically rainless, the little snow which falls soon disappearing; above a certain height no dew is deposited, and rapid alternations of temperature are the

* *Where Three Empires Meet* (Travels in Kashmir, Ladak, etc.), by E. F. Knight, 1893, p. 10.

† *Ibid.*, p. 105.

§ *Ibid.*, p. 105.

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great feature; the sun's direct rays are hotter than in India, while the afternoon winds are piercingly cold, and except in summer it freezes every night." *

Mr. Knight in further describing it says,

"Ladak, like Chinese Thibet is for the most part a desert of bare craigs and granite dust—a land where there are no forests or pastures, where in places one can march through a long summer day and never see so much as a blade of grass; a cloudless region, always burning, or freezing, under the clear blue sky: for so thin and devoid of moisture is the atmosphere that the variations of temperature are extreme, and rocks exposed to the sun's rays may be too hot to lay the hand upon, at the same time that it is freezing in the shade."†

In our section on Climates and Temperatures we have, as the reader will doubtless remember, not failed to lay considerable stress upon these rapid alternations of temperature, which are invariably found to succeed each other in dry and highly elevated regions: and nowhere is the truth of this phenomenon more clearly illustrated than in these mighty elevated table lands, which form such remarkable features in Thibet, Ladak, and other Himalayan hill states—which undoubtedly constitute the highest inhabited regions in the world.

It is here in consequence that the rapid variations between extreme heat and cold are most sudden and trying—the power of the sun's rays being actually more felt than upon the plains of India, while the instant that they are withdrawn, one is in the arctic regions. In South America for instance, the tropical sun may be blazing overhead in fiery glory, heating

* *Encycl. Brit.*, Vol. xiv., p. 197 (Art. "Ladak").

† *Where Three Empires Meet* (Travels in Kashmir, Ladak, etc.), by E. F. Knight, 1893, pp. 105—6.

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the surrounding rocks till they sometimes actually splinter and crack, as if exposed to the blast of a furnace, while the scanty vegetation which struggles for existence at rare intervals among their sheltered crevices, is that of the glacial region, whose brilliantly coloured flowers grow and flourish only under the dropping of water from melting snows. In the high Alps, which are annually visited by ever increasing numbers of our British tourists, these flowers are a never failing source of wonder and delight: and many of them will doubtless have remarked that the higher they climb the more brilliant does the Alpine flora become. In the very highly elevated regions of the Himalayas and the Andes however, owing to the extreme rarefication of the atmosphere, botanical and other researches become a matter of serious difficulty, and indeed of danger—for, apart from the ordinary risks inseparable from mountaineering, the stranger is here liable to severe attacks of a disease known to the Spanish colonists as "puña." This frequently comes on quite suddenly, without any previous warning, in the form of violent sickness of the stomach and vertigo, accompanied by difficulty of breathing, which obliges the sufferer at once to come to a standstill, and renders him in the case of a serious attack incapable of further progress without assistance, on account of the giddiness.

We have suffered from these attacks in our own person, and can speak feelingly as to their exceedingly serious and alarming nature: as a sudden failure of the heart's action, if exertion is persisted in, is liable to bring the traveller's wanderings to an abrupt and permanent close.

One such case, which had a fatal issue, we heard of

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from the Spaniards soon after one of our own journeys across the Andes; it was that of an English traveller, who from what we could learn, seems to have been a retired officer of the Royal Artillery. He became unconscious and never rallied.

Fortunately however, these severe attacks are comparatively rare: and perhaps there may be idiosyncrasy in the individual, or other predisposing causes—such for instance as organic disease of the heart.

We think it well however, at this point, to say a word of caution to travellers, tourists, and others who think of visiting high altitudes, or of indulging in mountaineering. Recollect, wherever there is a tendency to affections of the heart or the circulatory system, an ascent to high altitudes is always dangerous; and persons who have reason to suspect that they may be affected in this way should never attempt it without first consulting their doctor. Persons affected with valvular disease, will in fact often *drown* in rarefied air, much as a fish does when taken out of water. A fatal case of this kind once occurred at St. Moritz (6089 feet over sea-level) in the Engadine Valley, when we were there. While walking past the new English church one day, we observed a grave mound recently thrown up in the gravel, and on making enquiries we learnt from the doctor what had happened. It was the case of an English gentleman who had only recently arrived at the place, and who died just in this way. The funeral had taken place very early, at daybreak, and so close was the matter kept at his hotel, for fear of alarming visitors, that the fact of a death occurring in the house was generally unknown. For those who are strong, but *new* to the mountains,

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it is also always prudent to be a little careful at first, until the system has had time to become accustomed to the change, and till the "shortness of breath" due to the rarefied atmosphere, which at first affects newcomers at considerable altitudes, even on ascending a small thing like a flight of steps, has gone off.

When making steep ascents, stop and rest often, and admire the view.* Many a man has permanently injured his heart by overtaxing his strength while ascending mountains, and endeavouring to keep up with practised mountaineers before being in a condition to do so.

The effect upon the human system of great increases of altitude is often remarkable. There are places, for instance such as Potosi in Bolivia, a great silver mining centre, and one of the highest inhabited localities in the world situated at an altitude of about 13,600 feet over sea level, where, it is said, strangers are seldom able to reside with safety for any great length of time, and cats it is asserted always die if taken there. It is also a curious fact that the native residents are stated, on what seems to be good authority, to be endowed by Nature with a larger chest measurement than the people of the lowlands; they are in consequence able to take into the lungs a larger volume of air at each inspiration, than other people, and thus the highly attenuated atmosphere does not seem to affect them injuriously; but in the case of people not so constituted, the work thrown upon the heart and lungs is considerably augmented, beyond what is natural—it follows therefore, that this cannot go on for long, without the risk of grave injury to these organs.

* See some sensible observations on this head made in *Deer-stalking*, by Augustus Grimble, 1886, p. 23.

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On the other hand, under ordinary circumstances, and up to a certain point, the health-giving and bracing effects of mountain air are so well known that it would be needless to do more than record it as a matter of ascertained fact. In the tropics for instance, the value of a move to the hills is now admitted to have almost entirely changed the conditions of European life in these countries. In former days before these things were generally recognised, Europeans sent out to the East and West Indies used to die in a way that it is frightful to think of; whereas now-a-days these high rates of mortality are entirely unknown; mainly because troops etc., are no longer kept in pestilential quarters on the edge of the sea, and because sick cases are at once sent to the hills—but also no doubt partly through the cheapening of transit and the more general use of quinine, and last but perhaps not least, owing to the adoption of a more sensible system of clothing, the substitution of woollen for linen and cotton garments, together with the universal use of sun helmets. Sudden ascents from the plains in tropical countries to considerable elevations are however not advisable in cases of malarial diseases, as the tendency of the sudden change of climate is to bring out any germs of malarial fever that may be lurking in the system, and so precipitate an attack. Doctor S. O. Bishop of Darjeeling for instance, has written strongly upon the necessity of caution on the part of visitors from the Indian plains, when ascending to this station, a well-known sanitarium situated in British Sikkim, just about 7000 feet above sea level, and says,

"I have often noticed after arrival in a hill station, from the plains, that visitors, more especially those who come on account of their health, suffer from various indispositions.

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From my own experience (he goes on to say) I am confident if more care were taken, and more prudence exercised, a good deal of sickness could be avoided." *

There is a military convalescent depôt at Jelapahar, which adjoins Darjeeling; at the still higher level of about 7400 feet, within view of it, is the old and extensive military cantonment of Mount Senchal, now abandoned and in ruins; it lay at an elevation of 8610 feet over sea level, on the very crest of the ridge.

There is a curious story in connection with the abandonment of this latter place, whose ruins show that very great expenditure must have been incurred in its construction. Line after line of ruined barracks, and other buildings, may still be traced, which are now habitations only for the raven, the owl, and the jackal; even the mere work of levelling the parade ground alone must have been a process of very great labour and cost, scooped as it is out of the rocky crest of the ridge.

In connection with what perhaps might be termed our "croakings" about the necessity of caution in the use of hill stations, as tropical sanitaria, the story of Mount Senchal is well worth recording here. The place is about six miles by road from Darjeeling, and is passed on the way to Tiger Hill, a point over 9500 feet above sea level, usually visited by all who come to Darjeeling on account of the magnificent view of the mountains to be had there, and from whence a good view of Mount Everest, at present reputed to be the highest mountain in the world (29,002 feet) is obtained.

Senchal was selected for the site of the military

* *Medicals Hints for the Hills*, by Dr. S. O. Bishop, Darjeeling, 1888. Introductory Chapter, p. 1.

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cantonment, soon after the first occupation of British Sikkim in 1835, by the Indian Government during the governorship of Lord William Bentinck, who acquired it by cession from the Rajah, as a European Sanitarium, in return for an annual grant in money; and from a military point of view, there can be no doubt that a British force occupying Senchal held an exceedingly strong position, provided that Tiger Hill was duly held by a small fort. Herein, we find the explanation of many of the follies (or what are now reputed as such) committed in former times by the selection of what afterwards proved unsuitable localities from a sanitary point of view, on account of their strategical advantages, or their capacity for defence by a small force against superior numbers. Unhappily the military records of almost every country teem with similar cases, where the advantages of a position in its military and medical aspects appear to be in direct opposition to each other.

At Senchal, however, these conflicting interests were probably not apparent in the then state of sanitary science, for nothing at first sight could appear finer than its situation. It is impossible to conceive anything grander than the panorama of the great Himalayan snowy range, seen from these heights, from whence the mighty Kinchinjunga (28,156 feet) and many other peaks of 20,000 feet each, and upwards, are visible towering to the sky both on the northern and the western horizon; indeed a careful examination with a good glass shows more than one peak far to the N.W., and probably in the territory of Nepaul, whose altitude seems (at that great distance) to be quite as great as that of Kinchinjunga. Then facing round the other way towards the southward, the spectator gazes down into an abyss of

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enormous depth—the ravine is here said to be in fact nearly 7000 feet deep *—through which the "Great Ranjit" and "Teesta" rivers make their way down to the Indian plains; when it is still weather, and the set of the wind is favourable, the traveller's ear can at times detect from many points among these hills the dull roar of the torrent dashing along its rocky bed. Often very impressive indeed is the sound of its muffled thunder, heard echoing among these mighty solitudes. As the traveller rides along the mountain paths places are also frequently come upon, where the eye (provided the view is not interrupted by mist) can travel down to apparently fathomless depths, and see the torrent white with foam and just distinguishable in the gloom threading the tropical forest with a silver line. Looking down from Senchal toward the south, the view extends along the valley to a vast distance in the direction of the Indian plains, until at length the vista loses itself in the mist. It is by this valley that the present narrow gauge railway ascends to Darjeeling from Silliguri, a station situated near the outer edge of the Terai, fifty-one miles from Darjeeling.

The position of Senchal was therefore in every way most commanding and beautiful; a well-constructed road gave easy access to the cantonment, and led through what was then a magnificent forest of oak magnolia, and rhododendron, and though the heavy timber has since been cut, the whole place still abounds with rare and beautiful plants of many descriptions. When these were in flower in the months of April and May, Sir Joseph Hooker in his Himalayan Jour-

* *Himalayan Journals*, by Sir Joseph D. Hooker, edition of 1854, Vol. i., p. 122.

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nals, assures us that "the vegetation is, in some respects, not to be surpassed by anything in the tropics." * The white-flowered magnolia (*Magnolia Excelsis* [Wall.]) still forms a predominant tree at 7000 and 8000 feet, and in 1848, at the time Sir J. Hooker wrote, he states "it blossomed so profusely that the forests of Senchal appeared as if sprinkled with snow." † Above that again comes the range of the purple-flowered variety (*M. Campellii*) which seldom descends below 8000 feet. Then among the rhododendrons a leading variety here is *R. Argenteum* which "grows a great tree 40 feet high, with magnificent leaves 12 to 15 inches long, deep green, and silvery below." § Senchal also possessed the great advantage of an abundant supply of pure water of such excellent quality that pipes have of late years been laid to convey it to Darjeeling, for the use of that sanitarium, and the town at present draws its water supply from these splendid springs at Senchal. All these circumstances of course seemed to tell in its favour.

The causes however which eventually compelled the abandonment of Senchal, was its exposed position on the very crest of the ridge at the head of the valley leading up from the plains. This was a fatal error: because it ignored the fact, the truth of which has since been so generally recognised, that wherever mountains rise out of tropical plains, malarial fever of severe type invariably haunts the foothills and valleys at the base of such chains, and is carried up by the winds to very great heights. Now the pre-

* *Himalayan Journals*, by Sir Joseph D. Hooker, 1848, Edit. published 1854, Vol. i., pp. 125—6.

† *Ibid.*

§ *Ibid.*, p. 126.

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vailing direction of the winds in the case we are at present considering, is from the southwards, and comes directly up from the Terai towards the mountains.

As we shall revert again to the question of the Terai district, we shall at present content ourselves with merely mentioning the well-known fact of the highly malarious nature of its climate—so much so that it is stated on high authority that "it is almost inevitable death for a European to sleep there any time between the end of April and November," * and although great improvements have been effected of late years in the portion of the Terai lying between Silliguri † and Darjeeling, it must be remembered that this was not till long after the abandonment of Senchal.

Unfortunately the deadly nature of the vapours of the Terai belt at this point were only too clearly proved, in 1861, by a tragical event which cost the life of a most estimable lady, and no less a personage than the wife of Charles John, Earl Canning, first Viceroy of India; who, after crushing out the last embers of the Mutiny, was returning to Calcutta, after a triumphal progress through the North West Provinces early in November in that year. Lady Canning, who had been staying at Darjeeling, left that station with the intention of meeting her husband upon his arrival, and on her way down stopped one night in the neighbourhood of the Terai. This was of course before the construction of the railway—and during a

* *The Cyclopædia of India*, by Surgeon-General Edwd. Balfour, 3rd Edition, 1885, Vol. iii., p. 848.

† Silliguri is the junction of the metre gauge system with the 24 in. narrow gauge railway to Darjeeling.

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season when the country had been rendered more than usually unhealthy by excessive rains, which had accompanied the S.W. monsoon in 1861. Her Ladyship was in consequence attacked by jungle fever, and on reaching Calcutta about November 10, was found to be seriously ill. The disease rapidly assumed an alarming aspect, and she sank, and expired early on the morning of November 18.* The funeral took place at Barrackpur, the country residence of the Governors-General, 14 miles from Calcutta, on the banks of the Hooghli, at a lovely bend of the river, which was one of her favourite haunts. The traveller visiting St. Paul's Cathedral, Calcutta, will there find a magnificent monument erected to her memory. The epitaph upon it, written by Lord Canning, begins, "Honours and praises written on a tomb, are at best but a vain glory." †

Reverting however to the subject of the position of Senchal from a sanitary point of view. The results of all modern observations upon the subject of malarial disease all tend to show that there is no practical limit where it is possible to count on ascending beyond its reach upon mountains, as ravines seem to act as conduit pipes for conveying the poison along their courses into the higher regions. Malarial fever in its severest forms is therefore constantly found to attack unwary travellers and others, encamping in ravines. It is a matter of ascertained fact that there is no surer way of contracting severe attacks of this disease than camping or erecting houses in such situations.

This tendency of fever to attack persons among

* See *The Rulers of India Series*, "*Earl Canning*," by Sir H. S. Cunningham, 1891, page 211.

† A copy from the Author's Notes taken on the spot.

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mountains was well illustrated during the late Emin Pasha Relief Expedition in Central Africa, for there was nowhere that the expedition suffered more severely than in the lofty mountain region of "Ankori," almost every member of the caravan consisting of 1000 people having suffered from fever during their progress through this district; and Dr. Parkes, their medical officer, specially states that this occurred at high altitudes as well as low. "I may mention (he says) that we suffered from fever at all altitudes, up to 10,000 feet above sea level." * Dr. Parkes however thinks that many of these cases were caused by the keen air, and draughts, met with among the mountains, sudden chills being in that climate almost always followed by an attack of fever. It is probable that such causes may also have had considerable effect, and that they account in great measure for the well-known fact that persons coming from the plains often find an ascent to considerable altitudes precipitates an attack of fever.

All these circumstances however combine to show that from a sanitary point of view, the occupation of Senchal, at the head of an immense ravine, was most unfortunately chosen. In the Himalayas the early mornings are often beautifully clear, but as the sun gathers strength during the day, dense masses of vapour frequently rise from the valleys, and are carried up the ravines by the wind. From Darjeeling and other places, these mighty channels, worn by water out of mountain sides during the lapse of ages, are often to be seen filled with white smoke-

* *Personal Experiences in Equatorial Africa as Medical Officer of the E.P.R.E.*, by Thos. H. Parkes, Surgeon A.M.S., pp. 477—479 (pub. 1891.)

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like masses of vapour, almost as if it was water, while the atmosphere may remain perfectly clear above. When the fog therefore reaches the head of the ravine it is still propelled, and flows over the crest of the dividing ridge, and then floats like a belt of cloud along the higher slopes of the hills.

Senchal was therefore, owing to its position already described, almost constantly enveloped in these fogs; the scud of the mist, being thus carried across the ridge at that point, was sure to be charged, even at that elevation, with the miasmic vapours of the Terai below, hence as might be expected a great deal of sickness always prevailed there, such as rheumatism, dysentery, and febrile disease of severe type, and when the sun was thus veiled by mist, the cold was always very severely felt. A portion of H.M.'s 80th Regiment were in 1848 severe sufferers in this respect. It was also found that the combined effects of cold, the numerous cases of sickness, and the frequent prevalence of these fogs, produced a deep feeling of depression among the men who were quartered there; many of whom came up insufficiently protected with the necessary warm clothing, after a long residence on the hot plains of India. It is understood that there were several cases of suicide, and that things in fact became so bad, that had the command been retained there it came to this: that there would soon have been no men left to command. The place was therefore wisely abandoned, but not until after considerable losses had been incurred.

The change to the present position at Darjeeling, and Jelapahar, has proved in every way an extremely fortunate one, for from their position on the reverse

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slope of the dividing ridge, the fogs mostly pass up the valleys, or else overhead along the higher slopes of the mountains, in "the cloud belt" which we have already described. Darjeeling especially is comparatively free from these fogs. They however unfortunately often shut out the grand panorama of the snowy range from the sight of the casual visitor, as many days may sometimes elapse without a good view of it being obtained—the hot season on the plains, when Darjeeling is fullest, being unfortunately the season of rains and mist in the mountains.

The early morning at sunrise, before the mists rise, affords the best chance of getting a good panorama; that hour is therefore generally chosen by parties ascending to view Mount Everest, 29,002 feet and the highest mountain in the world, from Tiger Hill above Senchal. This gigantic peak is however only visible at a great distance (quite 120 miles) to the eastward, in the territory of Nepaul, and is in consequence easily shut out by mist. Visitors therefore ought to be early, and so time their departure from Darjeeling as to reach Tiger Hill as nearly as possible at or before the rising of the sun, when a grand panoramic prospect is visible on every side, probably unequalled, and certainly not surpassed by anything of the kind to be seen on earth. There are some things that make a lasting impression upon the memory; and we think we can say without fear of being taxed with exaggeration, that the view from Tiger Hill, at such times, is certainly one of these.

Its vast and spacious grandeur, extending over an almost boundless field of vision, and embracing quite a number of peaks, standing without rivals at the head of the list of the greatest altitudes existing upon earth

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—are all to be seen, standing out against an azure sky on clear mornings just at dawn, with that infinite coldness and distinctness of outline, peculiar to objects modelled in polished steel: whilst the splendid effects of sunrise enhance to the utmost the grandeur and beauty of the scene; its early rays tinting the masses of snow with glowing hues of pink and carmine. Thus every circumstance combines to form a prospect whose glories can never be effaced from the mind, either by time or distance or the strain and turmoil of a busy life.

The torrents, whose dull and ceaseless roar is often the only sound which breaks the silence amid the higher altitudes of great mountain ranges, form natural features in the landscape rarely or never found wanting in such localities. If a great mountain upreared its lofty crest alone in its glory in the midst of the dryest desert upon earth, it may be accepted as a matter of practical certainly that vapour would still be condensed upon its summit which would produce such torrents as are found to seam the sides of all high places. A rainless district may be ever so extensive, and yet the vapour-laden winds are still for ever bearing aloft across the arid waste those mighty water floods, which in due season are destined to descend upon earth and become the prolific sources of great rivers. There is no occasion to go elsewhere to seek for illustrations of this fact; for from Darjeeling, and all along the great northern plains of India, whose boundary is formed by the Himalayan range, we are everywhere surrounded by a vast region where this phenomenon may be seen in continual operation.

The plains themselves may be, and unfortunately

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frequently are, perishing for want of a drop of rain; crops may fail; the wind may sweep away the desiccated grass in the form of dry dust from the pasture lands; and the ground may be as dry and as hard as if paved with granite flagging; while famine affecting millions of the helpless inhabitants taxes the resources of the British government to the utmost, so that they are sometimes almost at their wits' end to devise methods for dealing with it (and here it may not be an unwarrantable digression to point out that the British is the only government that has ever *attempted* to really deal with such a crisis, and which has stood between the native population and death, on such occasions: for the native Princes were never able to do anything worth speaking of to assist them: while the Rajahs *talked* the people *died:* the people of India should never forget that).

Returning however to the point we were discussing, we desire to point out that notwithstanding all these troubles affecting the Indian plains country, the needful supplies of water are all the while ceaselessly passing across them in the zenith, to be deposited in the form of hail and snow upon the crests of the great Himalayan chain—upon whose foot-hills the rank luxuriance of its vegetation is ever flourishing, owing to the superabundant supply of this life-giving element.* We fear there are as yet no data to enable us to assert the fact in positive terms, but it seems to us to follow, as a matter of scientific fact, that the southern slopes of those mountains should then be (during the prevalence of these droughts) more heavily laden with

* See some observations on these vapour-laden winds, in the "*Himalayan Journals*" of Sir J. D. Hooker, 1854., Vol. i., pp. 106—7.

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snow than at ordinary times—because we know that under the torrid rays of a vertical sun the waters of the Indian Ocean *must* always be evaporating, and that the set of the prevailing winds for by far the greater part of the year is towards the northward —consequently, though not a drop of rain may fall upon the Indian plains, the water which should in the ordinary course of events have been deposited there by the S.W. Monsoon (which generally lasts from April to October in Hindustan), *must* be carried elsewhere before it is finally condensed. Now we know, as a matter of ascertained fact, that the snow line upon the southern slopes of the Himalayas comes down immensely lower than it does upon their northern face, indeed the differences of levels have sometimes been estimated at as much as 4000 feet; consequently, the vastly greater part of the atmospheric vapour is condensed *before* it crosses that great divide: consequently it would seem to follow that when the monsoonal rains fail upon the plains, they should be mostly deposited in that locality, *plus* the ordinary amount of rainfall usually descending there. The normal amount of rainfall in many places is however always very great; the average rainfall at Darjeeling for instance, amounts to 119.28 inches per annum. *

It may be however that the currents of water-laden air may be occasionally deflected into adjoining regions --or it may possibly be that at certain times they are carried over the crest of the Himalayas, before their vapour condenses; in that case of course, we should expect to find very exceptionally heavy snow falls on the great table lands of Thibet, or on the

* *Encycl. Brit.* 9th Edition, Vol. xii, p. 739.

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further ridges of this great mountain chain, which lie still further to the north.

On these matters however we fear, as we have said, that sufficient data do not exist to enable any positive opinion to be formed. We therefore venture to tender our own views upon them as a hypothesis only.

But whatever may be the operation of the law of Nature in these respects, it is certain that upon the Himalayas, as well as on all other great mountain ranges, vast quantities of water are condensed. In the higher regions above—16,000 or 18,000 feet over sea level—it is probable that nearly the whole of this is deposited as snow. Here therefore, we have a constant and never failing supply of stored up water for the torrents, which the sun's action causes to pour down their sides. The description of the formation of rivers by these means, more properly belongs to our next section, "The Region of the Great River Basins," so that we shall confine our remarks at present to the consideration of their sources, as *torrents* only, with regard to the question of the "denudation" of mountains by their action.

Taken in its largest sense, the phenomenon of denudation involves such mighty issues, as regards the future of our earth, and raises such a complex array of scientific questions, that the human mind might well hesitate in approaching so great a subject; we purpose however, at present, merely to venture upon a short survey of its action upon mountains.

If a child should ask us, What age are the hills? even the most uneducated person would say—They are old: very old. If the enquiry was pushed a step further, by the rejoinder of, How do you know? we

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have but to point to the work done by these torrents, to prove that it *must* have taken *ages* to perform it, how many ages it is unfortunately beyond our powers to determine. A little observation will teach us that rapidly running water can cut very quickly through a soft, or friable medium, as the injuries done to mountain roads by sudden storms sufficiently prove; at these times the whole surfaces of such roads are sometimes carried away in a few hours for considerable distances, so that their course is more or less completely effaced. But when it comes to the question of wearing channels through the solid rock, it must be obvious that it wears a very different aspect—and must have occupied a long period of time. Now near Iskardoh in Little Thibet, not far from the sources of the Indus, "is the wonderful gorge by which the river bursts through the western ranges of the Himalayas, said to be *fourteen thousand feet deep*" (or almost $1\frac{3}{4}$ miles in vertical depth).* How long did it take to cut *that?*

The River Indus rises approximately in Lat. 32° N., and Long. 81° E., in a lofty mountainous region, seldom visited by Europeans, and of which very little is known; exact data as to its head waters are therefore not available. Enough however is known to show that the great river has eaten its way literally for hundreds of miles through rock-bound gorges whose beetling cliffs form a strategic line upon the N.W. frontier of our Indian Empire of enormous strength and importance from a military point of view.† The crossing of the Upper Indus there is only fairly practicable for

* *Encycl. Brit.*, 9th Edition. Vol. x., p. 68. (Article "The River Indus.")

† See letter of General Sir John Adye in *The Times* of August 17, 1893. (He says it is "almost impregnable").

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troops at a few points of its course (and probably only during the cold season) from Attock to Sakka. According to General Lord Chelmsford this is "the only portion of the river frontier which is in any danger."* The river races with the speed of a mill sluice during floods, and all along its northern section these floods are liable to come down suddenly without warning of any kind, and sweep away everything in their course. At Attock for instance, where the main road to Peshawar crossed the river before the present railway bridge was constructed,† there used to be a bridge of boats, in accordance with the usual practice in India, where wide and rapid rivers liable to sudden floods have to be crossed, but this bridge generally had to be withdrawn in summer, when the melting of the snows on the mountains endangered it,§ and the Indus has been known to rise at this point quite *90 feet* in a single day.** We shall however revert to this subject again in greater detail in our next section, on "The Great River Basins." The danger to which an army would be exposed in leaving such a river unbridged in their rear must be obvious; upon its upper waters however near where the Indus enters the Punjab (in Lat. 34° 25′ N., Long. 72° 51′ E.) the river is fordable in many places, during the cold weather; but a few hours may convert the ford into a raging torrent. Thus Ranjit

* See report of an interview by a commissioner of the *Pall Mall Gazette* with Lord Chelmsford in that paper of the date of August 24th, 1893.

† Opened for traffic in May 1883 (a subway carries the road beneath the railway line); see *The Imperial Gazetteer of India*, by W. W. Hunter, Vol. vii., p. 15.

§ *Encycl. Brit.*, 9th Edition., Vol. iii., p. 62.

** See *The Imperial Gazetteer of India*, by W. W. Hunter, Vol. vii., p. 15.

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Singh is said to have lost a force of cavalry, variously estimated "at from 1200 to 7000 horsemen"*—while crossing this river, in consequence of one of these sudden freshets. For remarkable instances of sudden floods of this kind, from which even streams flowing through plains countries are by no means exempt, we beg to refer the readers to our section on Climates and Temperatures, where we trust many interesting details on the subject of sudden floods, without apparent cause, will be found enumerated.

To these sudden floods, mountain torrents are of course exceedingly liable; a very short interval of heavy rain being sufficient to render what was previously a dry stream bed, *quite* impassable; a very moderate depth of water, dashing rapidly down a hill side, being quite enough to carry off both men and horses. When the weight of the impact of water exceeds that of the man, of course he most certainly will be carried off. Now, the weight of each gallon of water is eight pounds, and the momentum acquired during its flow down a steep slope will cause it to strike any fixed object crossing its current with at least an equal and probably a much greater force—that being so, it no longer seems wonderful when we find immense rocks in the gorges of great mountains, which have evidently been carried down by the current. In the Himalayas, the Andes, and other lofty chains, such instances are common. Most persons who have had even a very moderate experience of mountains will also doubtless be able to recall many instances of the wonderful rapidity with which torrents swell, and how every little

* See *The Imperial Gazetteer of India*, by W. W. Hunter, Vol. vii., p. 11. (N.B.—This event occurred about the year 1823.)

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rivulet turns into a regular stream, at short notice. This was well expressed by Sheikh Saâdi, as recorded by Major Edwardes, where he said,

"You may stop the source of a river with a bodkin, but let it run on, and it will carry away an elephant and his load." *

Torrents proceeding from highly elevated sources, amidst heights heavily laden with eternal snows, possess peculiar features in that they are to a great extent independent of rains; the time when they are highest in point of fact, generally being in the hot season.

Being fed by the melting snows, these streams are generally low at night, when an intense cold, and hard frost, seals up the fountains of their supply; many of the smaller rivulets may even entirely cease to run: but no sooner has the day broken than the sun's rays again begin to melt the snow, and the stronger and clearer it shines the heavier becomes the flood which sweeps down from every ravine. On account of the rarefication and intense dryness of the air, the power of the sun may actually be greater than it is on the plains. †

Now as almost the whole of the water condensed from the clouds during the remainder of the year is at these altitudes stored up upon the mountain tops in the form of snow, it will be apparent that as long as these hot suns continue to shine, heavy floods are certain to roll down to the plains country from the snowy range. It is this that makes the freshets on the Indus, the Jhelum, the Sutlej, and other rivers,

* *A Year in the Punjab*, by Major Herbert B. Edwardes, 1851. Vol. i., p. 203.

† *Encycl. Brit.*, 9th Edition, Vol. xiv., p. 197. (Article "Ladak.")

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so serious, increased as they are almost sure to be by the monsoonal rains. The eastern rivers of India, in Bengal, and elsewhere, are of course affected in the same way, and during the height of the monsoonal rains the Ganges and the Brahmaputra sometimes resemble arms of the sea.

In many places among great mountains the ceaseless thunder of these mighty torrents, may be heard echoing among the hills with a volume of sound which fills the mind of the listeners with awe and wonder, and though their deep and sullen roar may be somewhat diminished by night, it often remains so loud as to banish sleep from the eyes of those unused to it--to others again it sounds like the voice of precious music to the ear, and seems to be continually telling of the greatness and sublimity of Nature, which is nowhere more apparent than on the ocean or among great mountains.

In the East, high mountains are almost universally regarded as sacred places. In India this is specially so among persons of the Hindu religion, who hold the sources of the sacred river Ganges, where it rises amid the Himalayan snows, in the deepest reverence. The true source of this river is deemed by them to be a point near Gangotri (situated in about Lat. 30° 55′ N., Long. 70° 56′ E.)* 10,300 feet above the level of the sea, where it issues from an ice cave, at the foot of a Himalayan glacier.† One of the best descriptions of this spot is to be found in the sporting tour of Colonel Markham, 32nd Regiment, made through this district about 1853, who says,

* Index Geographicus of Lat. and Long. compiled for Keith Johnston's *Royal Atlas*, 1864.

† See *Encycl. Brit.*, Vol. x., p. 68. (Art. "Ganges.")

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"Never can I forget my first impressions when I beheld it in all its savage grandeur. The glacier thickly studded with enormous rocks is about a mile in width, and extends many miles towards an immense mountain covered with perpetual snow, 21,000 feet high. The chasm through which the sacred river rushes forth, is named 'The Cow's Mouth' and is held in the deepest reverence by all Hindoos, and the regions of eternal frost in its vicinity are the scenes of many of their most sacred mysteries. The Ganges enters the world no puny stream, but bursts forth a river 30 or 40 yards in breadth, of great depth, and very rapid. * Extensive as my travels have been through these beautiful mountains, and amidst all the splendid scenery I have looked on, I can recall none so magnificent as the glacier of the Ganges." †

There can be no doubt that in these matters the imagination is influenced by the grandeur of Nature; a feeling of awe insensibly takes possession of the mind, and native superstition rarely fails to connect such scenes with the presence of the Divinity; thence it becomes but another step to associate them with events forming the basis of their various creeds.

The same train of thought causes eminences from whence extensive and striking views are obtainable to be selected for the sites of temples, etc. Speaking on this subject Sir Richard Temple says,

"There is hardly throughout the whole continent (of Hindustan) a fine or effective position, or commanding point of prospect, which they (the Buddhists) have failed to occupy with some structure." §

These positions most of them occupy eminences among

* N.B.—This was probably during the hot season, when the river was in flood there.

† *Sporting in the Himalayas, and Travel and Adventures in Chinese Tartary, Ladak, Thibet, Cashmere, etc.*, by Fredk. Markham, Colonel 32nd Regt. 1854, p. 58.

§ *India in* 1880, by Sir Richd. Temple, 2nd Edition, 1881, p. 26.

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hills and mountains, but others are upon the banks of great rivers, and especially at the confluence of such streams: the confluence of the Jumna and the Ganges, for instance, at Allahabad, is a good example of these last, where the sands at certain festivals may be seen covered at this point by thousands of these people, bathing in, and drinking the sacred waters; but the temple here is confined to a small one within the fort.

The wonderful rock temples of India however, constitute the most striking monuments of this kind. Many of these cave temples belong to Buddhism, and according to Sir R. Temple the total number of them thus far discovered, amounts to nearly 1000; * of these some are known to be effaced, whilst others exist in a defaced state, but many having been carved in the hardest rock, are imperishable.

"The fondness for excavating their sacred places out of the mountain sides (continues Sir R. Temple) was a characteristic of the early races of India."—"Often the traveller at the entrance, turning round, beholds the spreading landscape, the very prospect which the Buddhists of old commanded, as they contemplated the wealth and civilization of the plains and valleys at their feet, whence the support of their national institutions was derived." †

In Egypt a splendid example of one of these rock-hewn temples is to be seen in the Nubian desert at Abu Simbel on the banks of the Nile, between the first and second cataracts. The fondness of the ancient Egyptians for the construction of rock-hewn tombs, is also well known. Many of them date from periods of

* *India in* 1880, by Sir Richd. Temple, 2nd Edition, 1881, pp. 26 and 27.

† *Ibid.*, pp. 26 and 27.

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enormous antiquity, as regards the historical records of the human family. Many of these again are very extensive affairs, and represent a vast expenditure of human labour on what were probably partly tombs, and partly places of religious worship. With a good glass, the gaping entrances to literally thousands of such places may be seen in the cliffs and mountains, as the traveller ascends the Nile, every available spot at certain points being absolutely honeycombed with them.

Some of the carvings cut in the solid rock which forms the walls of these places, are wonderful examples of human skill and artistic talent. The four colossal sitting figures of Ramses the Great, which are hewn out of the cliff at the entrance to the Egyptian temple of Abu Simbel, are conspicuous instances of this, and from the doorway, but more especially from the heights above, magnificent panoramas of the barren hills and pathless expanse of tawny red sands peculiar to the Nubian desert, are visible; whose colourings, under the ruddy glow of sunset or sunrise, form spectacles of never-to-be-forgotten splendour. Most impressive at all times is its stern and spacious grandeur; its changeless aspect of infinite desolation, and deathlike repose, in which the only indications of life or movement are the waters of the mighty river, silently flowing at the base of the cliff beneath: otherwise there remains not a single trace of human habitation or existence, except the presence of the Nile boat that has borne the traveller to the spot, and waits to carry him off again.*

* It is usual for the tourist steamboats to pass the night at Abu Simbel, in order to enable passengers to witness both sunset and sunrise, and to see the temple by moonlight.

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Some of the Indian temples in like manner furnish magnificent specimens of these great rock carvings. In the more modern Buddhist cave temples, for instance, a very general adjunct is a more or less colossal figure of Buddha, either in a sitting or recumbent posture. The expression stamped upon the stony lineaments of the faces of not a few of these figures are often singularly beautiful, exhibiting artistic skill of a very high order: one hand is generally raised, as if the subject was in the act of addressing the beholder.

"The forefinger (says Sir R. Temple) solemnly points to warn men to look from mortality to immortality: from the seen things of time to the unseen things of eternity; and the hand holding a pinch of dust indicates the insignificance of all human greatness." *

The historical records of the Bible also show that this fondness for worshipping in high places existed in very remote times, all over Bible lands: where the earliest inhabitants of which history has furnished any record were probably sun-worshippers, and so were wont to assemble at such points of vantage to witness the first appearance of the great luminary of the day, as it rose upon the eastern horizon. In the Psalms, for instance, we find this sentiment of the sacredness of high places finely expressed in the words,

"I will lift up mine eyes unto the hills, from whence cometh my help." †

Sacrificial altars are also constantly mentioned as having been erected in such situations; thus Abraham, when

* *India in* 1880, By Sir Richd. Temple, late governor of Bombay and Lieut.-Governor of Bengal, 2nd Edition, 1881, p. 28.

† *Psalm* cxxi—1.

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about to offer up his son Isaac as a burnt offering, ascended one of the mountains of the land of Moriah. *

So again, when Balak, king of Moab, was desirous that Balaam should come with him to curse his enemies, he carried him up to the top of one of the high mountains to do so, from whence he could see the Israelitish army then encamped upon the plain of Moab. But as we know from the narrative, thoroughly Oriental in all its developments, which probably forms one of the most dramatic passages found in Scripture, Balaam, instead of cursing, blessed them altogether. † Those of our readers who have been travellers in Palestine will doubtless remember the striking panorama of the desert, and almost waterless hills, forming the range of the Mountains of Moab, seen to the eastward from the plain of Jericho and the shores of the Dead Sea, where these incidents were enacted, which afford tourists so fine an example of desert scenery: noble in its expansive and desolate grandeur.

But these striking, yet minor instances of mountain scenery, would fade into comparative insignificance, if placed where it would be possible to compare them with some of the loftier ranges, as for example the South American Andes, which also afford frequent examples of this same sort of perfect sterility and absence of animal or vegetable life. Both sorts of scenery in fact—panoramas of mighty wastes of barren rock and sand, or of umbrageous forest and grassy plains, when seen on great mountain ranges, have their own special features of sublimity; and it is difficult to say which is most impressive. We refer at

* See *Genesis* xxii—2.
† See *Numbers*, Chapters xxiii and xxiv.

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present to prospects of great mountains seen in the distance from the plain below. As pictures it may be that some of these may actually be the finest of all; and as such they are almost always selected by artists, in preference to those looking downwards, from above. But to our mind there is nothing that comes up to the spacious grandeur of the immense, almost illimitable areas of terrestrial expanse that can be witnessed, under favourable conditions, from the great altitudes. The sublimity of such prospects can hardly fail to impress even the most casual observer.

Nor is the feeling of awe with which, even unconsciously to ourselves, we look down from one of these altitudes upon the splendid panorama of the world unfolded beneath, by any means an unnatural one; on the contrary, nowhere does the greatness of the Creator appear more strikingly apparent nor the littleness of man in comparison so complete. There can be no doubt that it was this feeling which prompted the Buddhists to select for their temples these commanding positions of which we have spoken; from whence, according to the figurative metaphor used more than once in Scripture, "all the kingdoms of the earth, and the glory of them" are visible.

Many such positions, commanding an apparently boundless prospect, may be found upon the slopes of the Himalayas, the Andes, and even upon many smaller mountain ranges. Mr. Vigne, an early English traveller in Kashmir for instance, thus describes one of them,

"I well remember (he says) descending upon Chinini, after my last journey to Little Thibet. I had not seen the plains

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of the Punjab for nearly a year; and it was evening when they first suddenly burst upon my sight from the summit of the pass. They were still seven days' march distant, beyond the intervening ridges. So blue, so utterly boundless did they appear, that they might have been mistaken for the ocean, had not the silvery windings of the Tani showed them to be terra firma. I halted to enjoy the prospect that my fancy presented to me as something like a substantial emblem of infinity." *

In our own time, it has been our privilege to behold many such sublime panoramas; the recollection of which still remains present to the mind with unfading distinctness, affording a keen and ever-present sense of enjoyment. Speaking of such a place seen amid the wilds of Central Africa a recent traveller writes:

"It is wonderful what an effect getting to the top of a hill has on one's spirits and thoughts. I love to go alone on some mountain and look down from a great height. One seems more or less to leave all the littleness of one's nature in the valley below. With the wide view and pure fresh breeze, one's thoughts and ideas seem to expand, and become elevated—to be freer and better." †

Nevertheless the ascent of high mountains is by no means a thing that always repays the cost and labour of the attempt. Should conditions prove favourable the scenery is of course magnificent: but mist and cloud are so apt to settle upon the higher slopes of lofty ranges, that when the mountaineer succeeds in getting there, there may be little or nothing to see. Frequent disappointments occur in this way, as clouds often form

* *Travels in Kashmir, Ladak*, etc., in 1838—9, by Godfrey H. Vigne, 1842, Vol. i., p. 193.

† *Emin Pasha and the Rebellion at the Equator*, by A. J. Monteney Jephson, p. 295.

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with astonishing rapidity upon mountains, so that it is seldom possible to judge how long the atmosphere will continue clear.

The cloud-caps on mountains present several features worthy of attention. The most common form of these enshrouds the mountain tops with a screen of vapour, impenetrable to the eye. These clouds may rest immovably upon the higher slopes, even for days, when the atmosphere a few thousand feet beneath is quite clear, and the sun shining brightly, showing how thoroughly local are these cloud-caps, which are doubtless caused by the condensation of vapour caused by the cold of these great elevations. At other times a belt of smoke-like mist lies all along the breasts of the hills, leaving the summits perfectly clear; this form of cloud bank is very common on the Himalayas, and is probably due to the cloud meeting with an opposing current of air, at its upper limits, which prevents its ascending beyond that point.

In the rare instances where there are roads or lines of mountain railway, it is often possible by this means to pass up or down completely through the cloud-belt, into the clear atmosphere of the higher or the lower levels. We have seen a remarkable instance of this while descending the railway from Darjeeling, in the Sikkim Himalayas.* At Ghoom, 7407 feet over sea-level, on the crest of the ridge, the atmosphere was clear and frosty, descending to "Sonada," 6390 feet, the train entered the cloud-belt. At Toong, 5470 feet, the mist became very dense, and the wind fell to a dead calm. At Kursong, 4732 feet, no object was visible at over 50 yards. A little below this the sky began to clear; and at Mahanaddy, 4120

* Jan. 23rd, 1893. Details extracted from the Author's notebooks.

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feet, it was quite free from mist and the cloud-drift left behind about 100 feet overhead. At Gynbaree, about 3000 feet, the sun was shining brightly. Hence it appears that this cloud-belt was *about* 2000 feet in thickness. Reaching the plains, about 4 p.m., there was bright hot sun, but the cloud-belt was still distinctly visible on the hill sides and the summits of the hills arose above it, as before. We have seen the same phenomena on the Swiss Rigi-Bahn and elsewhere.

Another remarkable form of cloud-cap, is where the cloud stands motionless above, but *quite clear* of the hill tops, apparently (seen from below) 100 or 200 feet above their crest. On Table Mountain, at Cape Town, we have seen this occur on many occasions, while a very strong wind was blowing at the time. The explanation of this apparent incongruity, we venture to suggest, is that the variation of temperature on the mountain creates a fierce upcast of air, and that the cloud drift backs up under lee of the peak, in perfectly still atmosphere, just like water in the backwater of a rapid in a river. This seems the more probable, as it is always seen to windward. We have seen a very perfect example of this form of cloud-cap resting for over two hours above the Pic de Teneriffe, when a strong N.E. breeze was blowing. The cloud-cap was to the S.W., and hung quite motionless, while the peak remained in sight.*

Another constant source of interest and attraction among mountains is created by the alternations of sun and shade, which produce such continual changes of tints and colours in the landscape that there is always

* Seen from the seaward April 30, 1894, from the R.M.SS. *Norham Castle.*

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something new to attract the eye and charm the senses. But the grandest phenomenon of all is probably witnessed during one of the sudden storms which are of such frequent occurrence among high mountains. At these times the distant views are generally shut out by dense masses of rapidly driving cloud and mist, rolling up from the valleys, whilst the tremendous force of the gusts, the torrents of rain, hail, or blinding snowdrift combined with the deafening peals of thunder, frequently produce displays of Nature's power never to be effaced from the memory. No one can be really said to have seen the mountains, until he has beheld them during this war of the elements, as well as in their more placid moments of calm and sunshine. It is in fact impossible to conceive anything more grand and impressive or more awe-inspiring than the tumult that rages around one during the height of one of these tornadoes, with the deep voice of the thunder continually breaking in, like the heaviest artillery, pealing with truly appalling power among the surrounding hills. Travellers thinking of making ascents to their higher altitudes, should always closely watch the signs of the weather, as well as take counsel with the local guides, whom long experience has made more or less weather-wise: for to be overtaken by one of these storms, among the unfrequented crags or glaciers, far above the inhabited regions, is always a serious, and often an exceedingly dangerous thing, as in bad weather it is very easy to lose the way. Tracks become effaced with marvellous rapidity; tiny streamlets swell quickly into raging torrents; and the scud of the driving mist prevents any objects being discerned, except those in the immediate neighbourhood.

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This makes travelling of any kind always a very slow and difficult operation, and the night may close in upon the adventurer before he can extricate himself from his difficulties—or the impossibility of seeing where one is going on account of the fog may of itself alone, when the route lies through difficult and dangerous ground, compel the party to seek the nearest shelter that can be found, and come to a halt until the weather clears. But these storms may sometimes last two or three days, though this is fortunately a comparatively rare event; still it is never possible to make sure. It is therefore obvious that travellers may be exposed to very great danger and privations. Want of food, even for a single night, in the bitter cold of high altitudes will always be severely felt, and there is besides the constant risk of frost-bites, and of being overcome by the cold.

The recent melancholy death of Mr. N., a distinguished scholar and fellow of Oxford University, affords a good illustration of the risks to which climbers are subject from storms during mountain ascents. On August 25, 1892, he was attempting the ascent of Mont Blanc in company with two guides from Chamounix, and

"after leaving the Cabane of the 'Aiguille du Gouter,' (it seems) they were overtaken by a violent snowstorm, which blinded them and obliterated all tracks, the guides losing all reckoning of their whereabouts. After vainly endeavouring to recover the road, they dug a hole in the snow, and passed the night there. Next morning the storm continued with unabated violence. A start was made to risk an almost impossible descent, but after an hour's fruitless battling with the storm, Mr. N. fell exhausted and died, after shaking hands

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with both guides, and saying a few words in English, not understood. About 4 p.m. the weather cleared, and the guides made their way to the Refuge des Bosses, arriving there in a pitiable condition." *

The losses on the pass of the Great St. Bernard, and the story of the monks and their St. Bernard dogs, is a history of which almost every child has heard; and though the path is here clearly marked, and generally very easy to follow, the winter previous to our visit to the Hospice † a party (if we remember correctly) of no less than five Italians, were all lost in a snowstorm, by which they were overtaken while attempting to reach the Hospice from the Swiss side; and in 1825 all the dogs and three servants belonging to this Hospice were destroyed by an avalanche. §

But this is as nothing compared with the much heavier losses, which are of frequent occurrence among caravans crossing the high passes of the Himalayas. In these wild and lofty regions, tragedies of appalling magnitude have been recorded. For instance Mr. Knight, in his recently published book, mentions that a few months before he passed that way, a caravan of 300 mules and their drivers were overtaken by a storm and lost on the Gilgit road in North Western Kashmir.

"One has (he says) to pick one's weather carefully to cross a Himalayan pass in winter and spring, and when one does get a chance one must hurry over quickly, for the sudden fierce winds that often spring up are very formidable, and

* London *Times* of Aug. 29, 1892.

† Height over sea-level 8111 feet, and said to have been founded about A.D. 962 (see Murray's *Handbook for Switzerland*, 1891, 15th Edition, part ii., p. 433).

§ See Murray's *Handbook for Switzerland*, part. ii., p. 536.

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sometimes destroy whole caravans of travellers with their deadly cold." *

These passes are of course the only means of communication between Central Asia and Hindustan; and some of the better known and more generally frequented ones do a large traffic, and are crossed by large caravans of both men and animals. The Khyber Pass, from Peshawar into Afghanistan, is one of the most renowned and best known of these. Caravan days at present are Tuesdays and Fridays, and wheeled traffic for ordinary vehicles ceases at Jamrud (Lat. 33° 58′ N., Long. 71°30′ E.) the present British frontier station: [a permit is required for travellers proceeding beyond this point:] but a practicable road was constructed during the late war, which has since been kept in order, and considerably improved, as far as Ali Musjid, a hill fort forming one of the British advanced posts, beyond which point the pass is at present closed to Europeans, unless provided with a special order. Upon the occasion of our recent visit to the Khyber we took careful note of the traffic, and on the morning we started from Jamrud, a caravan of over 350 camels, besides a good many horses and donkeys, left for Afghanistan. We also passed a company of pilgrims, on foot, quite 250 strong, all bound for the north.

The Khyber pass is probably the safest and easiest of all the Himalayan passes, and is rarely incommoded by snow, the mountains being none of them much over 5000 feet over sea-level at this point. It is however subject to severe floods, which fill the streams occupying the beds of the ravines, converting them into torrents

* *Where Three Empires Meet, Travels in Kashmir, Ladak*, etc., by E. F. Knight, 1893, p. 103.

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which are sometimes so violent as to sweep away everything in their course. From Ali Musjid, the watershed is to the westward, towards Afghanistan, and the highest point of the Khyber pass is given as 3372 feet over sea-level, and 2300 feet above the level of the plain at Peshawar. *

Most of the Himalayan passes are however very much higher than the Khyber, and the elevation of their summits may be said to range from 12,000 to 14,000 feet, up to as high as 20,000 feet, but upon the southern range of mountains in Thibet, though the altitudes are often enormous, comparatively little snow is found up to 16,000 or 17,000 feet in summer, the condensation of aqueous vapours from the atmosphere having for the greater part taken place upon the southern eminences, as we have already stated.

We may instance the case of the country in the neighbourhood of the Zoji La pass, in Ladak, whose summit is given as 13,400 feet above sea-level, where at an elevation of 16,000 feet on the adjoining mountain slopes there is "often no snow in summer." † Professor Huxley in fact draws the snow-line on the north side of the Himalayas, at 16,600 feet. §

The *Encyclopædia Britannica*, a recognised authority in geographical science, goes further, and says that on the Indian watershed "the snow-line is not lower than 18,500 feet and on the summit of the table land (of Thibet) it reaches about 20,000 feet." ** For our-

* *Imperial Gazetteer*, 1868, Vol. ii, p. 75. (Article "Khyber Pass."

† *Where Three Empires Meet, Travels in Kashmir, Ladak*, etc., by E. F. Knight, 1893, pp. 105—6.

§ *Physiography*, by Professor T. H. Huxley, F.R.S., 1887, p. 64.

** *Encycl. Brit.*, 9th Edition, Vol. xi, p. 831 (Article "The Himalayas").

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selves however, as a result of our researches into existing data we are disposed to regard this estimate as somewhat overstated, if we are to regard that as the ordinary limits of perpetual snow in those regions, which accounts show might probably be fixed with greater accuracy at about 18,000 feet. But the snow-lines on mountains are apt to vary considerably from year to year according to the nature of the seasons. Some years when the average rainfall has been light it will be much higher than at ordinary times. Mr. Whymper, in his late work upon "Mountaineering among the Andes" of Ecuador, suggests that it would be better to abandon the attempt to fix a perpetual snow-line upon mountains, because, as he explains at some length, he regards it as misleading on account of the difficulty in determining what the snow-line really is, or the quantity of snow which would entitle a mountain to be classed as one having a permanent snow-line. *

The term however is a convenient one, provided that it is clearly understood to mean merely the approximate limits of perpetual snow which exist upon ordinary occasions, according to the best available data; bearing in mind that, like the depth of a river, it is liable to constant variations—it is conceivable for instance, that a violent storm beating upon a particular point, might denude a considerable area of newly fallen snow, and as we know, large extents of exposed ridges and steep slopes are often seen at very great elevations, surrounded by eternal snows, † but remain themselves kept quite

* See *Travels among the Great Andes of Ecuador*, by Edwd. Whymper, 1892, pp. 346 to 348.

† See *The Alpine Guide to the Central Alps*, by John Ball, F.R.S., p. lxi of Introduction. (Such instances are also to be seen upon most lofty mountain ranges).

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clear of snow by the action of the winds. So also, snow slides, descending a steep incline during heavy storms, may bring down large masses of snow, some of which may remain unmelted throughout the year, at a point much below the usual limits of permanent snow —it is therefore evident that the question of snow-lines is one which is beset by many uncertainties, and is liable to vary according to the interpretation which is put upon the facts.

As regards the snow itself, its condition is also subject to considerable variations, according to the latitude and climate of the region where the mountains are situated, and also according to the state of the weather at the time of the snowfall. In northern latitudes, for instance, when snow has fallen during perfectly still weather, accompanied by an intense cold, it is often, when examined under a magnifying glass, found to consist of regular crystalline forms of exquisite beauty. The different types of these snow crystals, as they occur in the arctic regions, have been minutely described at greal length, and by means of illustrated diagrams, by Captain W. Scoresby, the arctic navigator. * The same thing has been noticed as regards the snow falling upon the high Alps, when the air is calm. But "when the atmosphere is disturbed the snow assumes a new condition, which is that of small frozen pellets, a little larger than a pin's head." †

It is this which forms the blinding dust well known

* See Scoresby's *Arctic Regions*, Vol. i., pp. 426 to 432 and plates viii to xi inclusive, of 96 different forms of snow crystals.

† See *The Alpine Guide to the Central Alps*, by John Ball, F.R.S., p. lxi of Introduction.

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to those who have had experience of Alpine "Tourmentes." This is also the condition of the snow falling during the intense cold accompanying blizzards, during winter in the Hudson Bay Territory, and other parts of the great plains of North America. It is called "poudré" by the French Canadians, and is often almost as fine as flour; in this dry state it will neither cake nor bind, and brushes off clothes without damping them, exactly like dust. It is this sort of snow also which forms what are known by Alpine guides as "Staub Lawinen" or "dust avalanches." * On account of its loose nature and lesser weight, these slides of dust snow, though much more frequent and liable to occur after every heavy fall of snow, are on the whole less destructive than those formed of snow in a more or less consolidated state.

Many cases have been recorded for instance of men, and especially of animals, that have been buried for many days and even for weeks in dust snow, but have eventually worked their own way out, or have been rescued by searching parties. This is explained by the quantity of air that is contained in loose snow, which enables the entombed creature to breathe freely, whereas living beings caught in slides of consolidated snow (called "Grund Lawinen" in the Alps) are very generally crushed to death by the weight of the moving mass.

When the sun by day and frost by night have had time to act upon fallen snow it is gradually converted into a heavy, white, opaque and granular mass, of great weight, which frequently carries with it in its descent

* See *The Alpine Guide* (to the Eastern Alps), by John Ball, F.R.S., p. lxviii. of Introduction.

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large quantities of earth, gravel and stones. These "ground avalanches" usually occur in spring, when the melting of the snows has set in, and are then of course of a much more formidable nature than avalanches of newly fallen snow.

One of the most remarkable phenomena accompanying avalanches, is the blast of air which they carry with them: this rush of air, like that which accompanies explosions of various kinds, may at times prove very destructive, and extend its influence for a considerable distance on each side of the track of the avalanche; it is said that even forest trees growing near are thus sometimes uprooted and laid prostrate, *without* having been touched by the avalanche. Thus in 1819 the village of Randa in the Visp had many houses destroyed by the blast accompanying a falling glacier, * and the east spire of the convent of Disentis was thus thrown down by the wind of an avalanche which fell more than a quarter of a mile off. †

The explanation of this phenomenon is not far to seek; the vast bulk and momentum of the falling mass is sufficient to create extensive displacement of the surrounding air, which is impelled with a sudden and violent rush on either side, and in advance of the track of the avalanche, which thus has within certain limits all the force of a violent tornado. Air, we must always remember, though a very elastic gas, is subject to considerable pressure at the earth's surface, which at mean sea-level is estimated to amount to 14.7304 lbs to the square inch: and thus, as all experience shows, when in rapid motion it represents a force whose

* See Murray's *Handbook for Switzerland*, 15th Ed. 1891—part i., p. 69.
† *Ibid.*, part i., p. 69.

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magnitude it is not easy to place a limit upon. Wind moving at the rate of 100 or 120 miles an hour will thus (in the form of a hurricane) be capable of levelling most structures erected by human hands which lie directly in its path.

We propose to close this section with a brief review of the phenomena exhibited in great mountain regions among the representatives of the vegetable kingdom, which are not a little remarkable. The slopes of lofty mountain ranges in fact constitute everywhere quite a little world of their own, and at different elevations their sides are marked by special belts of vegetation, from the level of the plain to the limits of eternal snow.

It is a well ascertained fact that the range of plant life is everywhere dependent upon temperature, combined with the quantity of moisture contained in the atmosphere, and the amount of the rainfall. The geographical distribution of plants therefore depends almost altogether upon climate, the nature of the soil being with the great majority generally a matter of comparatively minor consideration. It is true that certain sorts of plants are much more fastidious in their nature than others, and will only grow under certain conditions, as to soil, aspect, etc. These plants however constitute the minority, and the main principle which governs the general aspect of the vegetation of a country is climate. Now upon the slopes of a great mountain every sort of climate prevails, according to altitude, varying from that of the plain out of which it takes its rise to that of the Arctic Zone. So again in many parts of the world, one side of a mountain range will have abundant moisture and copious rainfall, while on the other, in the same parallel of latitude, there

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will perhaps be a dry atmosphere and very scanty rainfall. These conditions, it so happens, are characteristic of the climates upon all the world's greatest mountain regions, notably for instance, upon the Andes, the Himalayas, the Rocky Mountains, the Sierra Madre, and many other important chains.

Furthermore from the very nature of things, almost every variety of soil and aspect is to be found upon extensive mountain ranges. The surface soil is washed down by rains and streams into valleys and hollows and forms more or less extensive areas of land of superexcellent fertility, while in the immediate neighbourhood will very likely be extensive tracts of gravel and rock, where trees and plants flourishing in those descriptions of soil find their natural habitat: consequently almost every species of vegetation finds some spots adapted to its necessities, where it can grow and flourish. Hence the magnificence of the timber and other growths which are constantly met with upon the mountain sides, often strikes one with surprise, especially when the apparently barren situations, where they are often seen growing, appear to be destitute of any regular surface soil, and consisting almost entirely of dry sand and gravel, or the detritus fallen from cliffs and other rocks. In such situations, where it sometimes seems difficult to imagine how they can find sufficient nutriment to sustain life, splendid trees are often seen, the secret of their growth being that the fertile portions of the soil are mixed with or overlain by an exterior coat of gravel, etc., which is constantly being carried down from above, while rich veins of mould exist beneath, where it has been washed in amongst the stones, into which the roots penetrate sometimes to very great

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depths and draw their nourishment from unseen and inexhaustible stores of soil and moisture.

In equatorial and tropical regions where the range of climate is necessarily greatest, as might be expected, all the different zones of vegetation will be found to be well and clearly represented, and in such situations a lofty mountain will often exhibit, between its summit and its base, a complete epitome of the vegetation of all the different climatic zones from the equator to the pole. Professor Meyen has divided the surface of the globe into eight great Phytogeographical divisions * or ranges of vegetation, represented on the plains by horizontal zones, and on the mountains by an equal number of vertical ranges, or regions, corresponding with the former in their respective productions, as follows:

1. The Region of Bananas—from sea-level to an altitude of 1900 ft.
2. The Region of Tree Ferns and Figs—from 1900 ft. to 3600 and 3800 ft.
3. The Region of the Myrtaceæ and Laurineæ—from 3800 ft. to 5700 ft.
4. The Region of Evergreen Dicotyledonous Trees—from 5700 ft. to 7600 ft.
5. The Region of Oaks and European Dicotyledonous Trees—from 7600 ft. to 9500 ft.
6. The Region of Abietineæ—from 9500 ft. to 11,500 ft.
7. The Region of Rhododendrons—from 11,500 ft. to 13,300 ft.

* *Outlines of the Geography of Plants*, by F. J. F. Meyen, M.D., Professor of Botany at the University of Berlin—translated by Margaret Johnston for "The Royal Society," London 1866, p. 157.

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8. The Region of Alpine Plants—from 13,300 ft. to the region of perpetual snow. *

Of course in fixing the approximate limits to these various regions Professor Meyen does not mean to convey that hard and fast lines are drawn at these points; on the contrary, he is careful to point out that the division of mountain flora into regions is, like everything else, open to objections, and that on different mountains in the same latitude there are sometimes differences of several hundred feet in the vertical limits of the same vegetation. † Nevertheless there can be no doubt that the plan of dividing vegetation into a tabulated system of zones, or regions, at the different levels which the mean results of numerous observations show that certain leading classes of plants generally disappear, and others take their place, is a convenient and useful guide to the student of Nature. It will no doubt be easy to show that sometimes Professor Meyen's limits do not accurately represent the range of plants in certain districts, but more often it will be found that at *about* these altitudes, they do as a rule cease to appear.

It will be easy to show, for instance, that the banana will grow far above 1900 feet above sea level; but if so it will be *not* as a natural habitant, but as an exotic —thus at Darjeeling with a mean elevation of some 7200 ft. over sea-level, there is a small botanical garden, in which the banana may be seen growing in the open air. It lives, that is all that we can say, but it is

* *Outlines of the Geography of Plants*, by F. J. F. Meyen, M.D., Professor of Botany at the University of Berlin—translated by Margaret Johnston for "The Royal Society," London, 1866, pp. 223 to 250.

† *Ibid.*, p. 223.

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neither handsome nor useful, but is a remarkable example of how the flora of the plains country will gradually become acclimatized, even at great altitudes. Settlers are constantly bringing up offsets of the banana and trying them, with varying success, at higher elevations in these mountains, so much so, that we have more than once found ourselves mentally debating the question, will the day ever come when bananas will become so far acclimatized as to grow in England. They have already reached Algeria, the Canary Islands, and Madeira, where they produce eatable fruit, though they are strictly speaking habitants of the equatorial zone. On the other hand the cocoa-nut will allow no such liberties to be taken with its species, and so far as we could judge by careful observations and enquiries in Ceylon, it ceases to grow, at present, just about 1900 feet above the sea. Passengers on the railway from Colombo to Kandy can see it for themselves. The cocoa-nut (*Cocos Nucifera*) disappears just above Nawalapitiya, a station on the line which the ordnance survey shows is 1913 feet over mean sea-level.

That Nature does place more or less fixed limits to the range of the different forms of vegetation is plain to be seen by an attentive observer of a great mountain range, and with a good glass he can actually see where the zones which she has drawn on the mountain sides begin and end. Very interesting and instructive is this examination of distant hills, still covered by the natural forest, by the aid of a powerful glass, which we look upon as a *sine qua non* in making out the details of a wild country. In the tropics, for instance, the traveller can see where the palm trees gradually become blended among a different class of trees, and then cease to appear. There

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is no hard and fast line. Nature's operations are always gradual, but nevertheless the general average limit appointed for the palm tree, which forms such a conspicuous object in the tropical landscape, is plain to be seen, and there it generally merges into an evergreen forest of quite a distinct class of trees, which thrive in the cooler atmosphere just above the region of the palm. Considerably higher up again, it will be seen where the evergreen forest gives place to deciduous trees, whose leafless arms form a very distinct object in such a landscape in winter time, and mark beyond the possibility of a mistake how the increasing altitude is accompanied by a constantly decreasing temperature.

This decrease of temperature may be fixed approximately at about one degree of Fahrenheit for every 300 feet of increased elevation; * and in the same way we may venture to assign 86° F. as the approximate normal temperature of the tropical day at sea-level throughout the torrid zone. But to proceed, and directing our glass still further aloft, towards the mountain tops, we generally find that above the region of deciduous trees there comes a dark green belt of coniferous forest, which is of course very distinctly marked upon the hill sides; where that ends, a thin and straggling belt of bush, consisting of willows and other similar trees, appears, which forms the highest region of arboreous vegetation (where there are no rhododendrons), above which the great grass region of the higher mountain slopes supplants the growth of trees entirely, except were the bush runs up in sheltered hollows and ravines; while above all comes the glacial region of sterility, or eternal snow. Such, viewed from a dis-

* *Encycl. Brit.*, 9th Edition, Vol. xi., p. 829.

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tance by the aid of a glass, is a general outline of what may be seen on the slopes of most great mountains, but to determine its exact botanical features of course requires a regular investigation by a skilled observer going all over the ground.

In what we may call the glacial region, vegetation almost ceases. Nevertheless mosses and lichens still continue to exist on rocks, sometimes for a considerable height above the snow line. Thus on Chimborazo, the great volcano of Ecuador, lichens were observed by Mr. Whymper up to 18,400 feet. Even an earthworm was found by him on the summit of Corazon at 15,870 feet, and specimens of butterflies and moths reached about 16,000 feet. * This finding of a delicate insect like a butterfly at these great altitudes and amid the rigours of an arctic temperature is a curious circumstance, but the same thing has been observed on the Himalayas, at even considerably greater heights. In the account of the British Government Expedition from Lahore to Yarkand in 1870, under command of Sir Thos. D. Forsyth, for instance, the existence of a spotted butterfly (*Parnassius Acco*) is duly recorded as having been observed near the highest point of a pass, known as "Cayley's Pass," 19,600 feet over sea-level, at a point where there was no vegetation within ten miles. †

The enormous height of many of these higher Himalayan passes is all carefully detailed from measurements

* *Travels among the Great Andes of Ecuador*, by Edward Whymper, 1892, pp. 350 to 353.

† *Lahore to Yarkand, Account of the Route and Countries traversed by the Expedition under Sir T. Douglas Forsyth*, by Geo. Henderson, Medical officer to the Expedition, and Allan O. Hume, F.Z.S., published 1873, p. 74. For name of Butterfly see list at end of the Vol. p. 305.

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taken on the spot in this interesting and valuable work, the expedition having traversed a section of country consisting of a tremendously elevated region, in its march from Leh, the capital of the Hill State of Ladak, to Yarkand, which latter place is situated in the great Central Asian plains, to the northward of the Himalayas, in Lat. 38° 24′ 1″ N., Long. 77° 15′ 55″ E., at an altitude 3,923 feet above sea-level. The reports of this expedition give almost the only really reliable account of this wonderful region which exists up to the present. The whole of the party, as might be expected, suffered severely from the cold, and from the extreme rarefication of the air, while crossing these great altitudes, and many of their baggage animals perished from the same cause. Almost the whole of this route lies in what we have designated as "The Glacial Region," which we have already spoken of as the last and highest of the climatic zones in the great mountain regions.

One of the curious facts connected with these great altitudes, which we ought not to pass by without remark, is the difficulty which is experienced in cooking anything, on account of the reduced pressure of the atmosphere. We need hardly remind our readers that water boils, at sea-level, at a temperature of 212° Fahr., and that its boiling point is reduced progressively, according to the increase in the altitude. The decrease in the boiling point is ascertained to be one degree Fahrenheit in the first 521 feet over sea-level, where the boiling point is 211° F., but this proportion slowly increases with increasing altitude, and that being so, advantage has been taken of the circumstance to determine the heights of mountains by the boiling points

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of water, for which purpose a regular set of tables has been computed, * by the help of which and some simple arithmetical calculations, the approximate height at which the observer then stands above mean sea-level is at once indicated. The results however are not altogether reliable, as different thermometers will be found to vary considerably when their boiling points are tried against each other at the same time and place, as also will their indications of atmospheric temperatures. This however involves a number of technical considerations, which are outside the limits of our present purpose: we shall therefore merely say that at 18,000 or 19,000 feet above sea-level, the boiling point is so materially reduced † that the finger can be plunged into boiling water without scalding it, and the difficulties in cooking things of course become greatly increased. The report of the Expedition to Yarkand for instance, states that "our servants found it impossible to cook pulse, and tea required to be actually boiled for some time, instead of being only infused." § The same fact has been frequently noticed by travellers in different parts of the world, while crossing high mountains, and the thing becomes a matter of serious moment, when one is accompanied by a lot of native servants, who live almost exclusively on rice and things

* See "Tables" for the determination of heights by the temperaturl of boiling water etc. in *Hints to Travellers*, Edited for the Counci of the Royal Geographical Society—5th Edition revised to 1883, pp. 181 to 185.

† At 19,300 feet water will boil at about 177° Fahr., and a further ascent of about 585 feet will at this great elevation cause the boiling point to fall one degree lower.

§ *Lahore to Yarkand, Account of the Route as traversed by the Expedition under Sir T. Douglas Forsyth*, by Geo. Henderson, Medical Officer to the Expedition, and Allan O. Hume, F.Z.S., 1873, p. 76.

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which require to be properly boiled before they become eatable.

At the Hospice of the great St. Bernard, situated at the top of the pass over the Alps, 8111 feet above the level of the sea, for instance, it is stated, on the authority of Murray's handbook for Switzerland, that the conditions for cooking are so much less favourable than on the plains, that "it requires 5 hours to effect that which at a lower elevation may be done in 3 hours."*

The cold in the Glacial Region of great mountain ranges is of an exceedingly penetrating nature, and in conjunction with the lowered vitality of the system caused by the rarefied atmosphere, which renders every form of active exertion extremely difficult and exhausting, it becomes harder to bear than if experienced at a lower level. The reports of the expedition to Yarkand show that on the great table-lands of Thibet its effects were greatly felt, for it is stated, that

"Encamped on the plain at 17,300 feet, we experienced great discomfort from the high wind, which begins almost every day to blow from the W. and S.W. about 10 a.m., and increases to a hurricane in the afternoon. Then it gradually subsides, and at midnight the air is calm again. Travellers have not infrequently been killed by this wind, which at times is so cold as to destroy vitality in a very short time. Both men and horses now suffered greatly from the rarity of the air, and some of our men lay down on the plain completely exhausted." †

This condition of the atmosphere renders respiration so laboured that travellers from the plains find them-

* Murray's *Handbook for Switzerland*, 1891, 15th Edition, Part ii, pp. 533—4.

† *Lahore to Yarkand, Account of the Expedition, Route and Countries traversed under Sir T. Douglas Forsyth*, by Geo. Henderson, Medical Officer to the Expedition, and Allan O. Hume, F.Z.S., 1873, p. 77.

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selves obliged to keep the mouth constantly open, and pant after the slightest exertion, exactly as if they had taken a smart run. The cold air thus obtaining admission into the mouth and lungs is likely to give rise to considerable risks of various kinds of ailments, one of the most frequently annoying of which is toothache, as also congestive inflammation of the respiratory organs.

If a man has carious or defective teeth, the keen air is almost certain to affect such teeth, and cause severe toothache. The teeth therefore should always be seen to before setting out upon a trip through a highly elevated region. It is however fortunate that the cold at these altitudes is always very dry, the risks of lung troubles, etc., being thereby greatly minimized, and there can be little doubt that it is owing to the dry condition of the atmosphere that the wild animals which inhabit the higher ranges of great mountains are enabled to support the cold constantly prevailing at these great altitudes. There are several descriptions of game animals whose natural home lies entirely above the limits of the forest growth, upon the rugged and grass covered slopes which intervene between the trees and the snow line. These animals are mostly of the goat and sheep family, and some of them rarely or never descend to the wooded portion, but even during the severest winters continue to find shelter and sustenance on rugged and precipitous slopes, where the freezing winds which sweep these barren heights generally keep them pretty free from snow. For instance Colonel Kinloch thinks that the Burrel (*Ovis Nahura*) which inhabits the bleak table-lands of Thibet and the higher Himalayas generally, is probably

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"never found at a lower elevation than 10,000 feet." * The great Thibetan sheep (*Ovis Hodgsonii*), said to be the largest wild sheep yet discovered, is another of these creatures whose home is thus described by Colonel Kinloch:

"On the wild bleak uplands of Thibet, where for hundreds of miles not a tree is to be met with, where in every direction, as far as the eye can reach, there is nothing but a vast expanse of barren soil, rock and snow; where there is no shelter from the glare of a cloudless noon, nor from the freezing winds that sweep the naked hills with relentless force towards the close of day; here, in the midst of solitude and desolation, where animal life has to struggle for existence under every disadvantage, is the home of this great wild sheep."†

Of the wild goat species we may mention the Tahr (*Capra Jemlaica*), the spiral-horned markhoor (*Capra Megaceros*), and the straight-horned variety (*Capra Jerdoni*), and last but not least, the splendid Himalayan ibex (*Capra Siberica*) whose finely curved horns sometimes measure 43 or 44 inches in length. All of these are animals inhabiting the great Himalayan range and are rarely found descending to the limits of the forest. In North America we may cite a similar instance in the big-horn, or great American wild sheep (*Ovis Montana*) which inhabits the highlands of the Rocky Mountains and other lofty hills in the far west. Colonel Dodge considers that "this splendid animal ranks, among the horned beasts of the Great West, next in size to the elk." §

* *Large Game Shooting in Thibet, the Himalayas and Northern India*, by Colonel Kinloch of the King's Royal Rifle Corps, Calcutta, 1885, p. 163.

† *Ibid.*, p. 170.

§ *The Hunting Grounds of the Great West*, by Richard J. Dodge, Lt.-Col. U.S.A., 1877, p. 205.

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It is a remarkable fact that wild sheep of different kinds, unlike their domesticated relations, are all denizens of rocky precipitous mountains of great altitude, where they can enjoy a very cool atmosphere and feed upon the sweet tufted grasses that grow at intervals among the crevices of the rocks. The soft fleece of the domestic breeds is also unknown among the wild varieties, whose coats consist of a species of coarse hairy wool, which is nevertheless admirably adapted to protect them from the rigours of the glacial region which they inhabit.

There are of course numerous animals which ascend to the great region of high pasture lands, during the heats of summer, mainly probably with a view to get away from the heat and the attacks of flies, which at this season in many parts of the world render the woods and lowland pastures almost uninhabitable. The herbage of these high slopes is mostly short and close growing, forming an excellent pasturage, one of whose peculiarities is the enormous quantities of wild flowers, with which Nature has adorned them, full of brilliant colours, and many of them possessing a powerful aromatic fragrance. Charming bouquets of these wild flowers of many kinds may here be culled by those who are admirers of floral beauty.

But above all, from these lofty eminences, the traveller or the sportsman, if favoured with clear weather, can make sure of enjoying bracing air and some of the grandest scenery which it is possible to behold.

If he is a prudent man and not pressed for time, or if as an experienced hunter he has come in search of sport, he will probably stop often, and sit down and scan the surrounding expanse with careful minuteness

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by the aid of a good glass, in order to ascertain whether game is feeding or lying down anywhere upon the adjacent slopes. There is no object in hurrying over the ground, for the hunter who does so is pretty sure to be observed by the sharp eyes of game, long before he detects their presence. His success therefore in such case is likely to be small. All this leaves plenty of opportunity to admire the scenery, and every now and again vistas between the hills will open out distant prospects of miles of leafy forests, or of dark and apparently fathomless valleys, far beneath, or else perhaps of sunlit plains spreading forth in the lowlands somewhat veiled in mist, like the blue expanse of some vast and silent ocean; for from these great elevations and at these great distances, irregularities of surface become merged into one apparently level expanse which to all intents and purposes exactly resembles a distant sea. And if in the course of his wanderings upon the mountains the visitor fails to see much that is worthy of his highest admiration, and comes away from them without carrying away with him a lasting recollection of the grandeur and beauty of the mighty panorama that is spread out before him, why the fault will be his own, and not that of the object lesson which Nature has exhibited to his gaze.

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CHAPTER XII.

THE GREAT RIVER SYSTEMS.

Rivers Constructing their Own Channels. Varieties of River Tracks. The Mountain Track. The Valley Track. The Plains Track. River Estuaries. Bars. Bar of the Columbia River. Estuaries free from Bars. Great Estuary of the St. Laurence. Inaccessible Estuaries. Process of Formation of a River Channel. Rock-cut Gorges. Chains of Lakes. The Great American Lakes. Niagara. Formation of Alluvial Plains. The Great Plain of Northern India. Evidences of its Fresh Water Origin. Its Vast Extent and Monotony. Flat Gradients of Indian Railways. Results of Borings in the Indian Plains. The Tertiary or Marine Strata underlying it at Great Depths. The Great Plains of Central Asia. Their Gigantic Size and Treeless Character. Area of the Steppes. Steppe Ravines. The Drifting Snows. The Great Indian Plain and the Steppes Contrasted. Water in the Architecture of Nature. Its Rock-cutting Power. The Carrying Powers of Water. Torrents. The Imatra Torrent. Himalaya Torrents and Ravines. Their Vast Depth. Wonderful Gorge of the Indus near Iskardoh. Rise of the Great River Systems mostly in Unknown Solitudes. Their Waters Lost in the Ocean. Classification of Water-borne Debris. Power of Streams Flowing at Various Speeds. Matters held in Chemical Solution. Precipitation. Annual Discharge of Silt by the Thames. Effects of Denudation in the British Islands. Sedimentary Deposits and Formation of New Lands. River Deltas. The River Amazon. Its Navigable Extent. Its Great Tributaries. The Ganges. The Sundarbans. Influence of the Tides in the Ganges Delta. The Ganges and the Bramaputra in the Rainy Season. The Ganges Channel from Benares to the Sea. Causes of the Impetuous Current during the Rains. Water as an Inclined Plain. The Cross Sections of Rivers. The Hooghly at Calcutta. Its Terrible Currents and Shifting Sands. Accidents to Shipping. Cyclones in the Bay of Bengal. The Nile Delta. The Nile Mouths. Nile Mud. Agriculture in the Nile Delta. The Nile Valley. Central African Lakes. The White and the Blue Nile. The Nile Tributaries of Abyssinia. The Cataracts of the Nile. The Great Nubian Desert. The Caravan Trade. Inundations of the Nile. Struggle of the Nile with the Desert. Sâkiyehs. Es Shâdûf. Irrigation Canals. The Equatorial Rains. Progress of the Inundation. The "Lêlet-en-Nuktah." Festival of the Letting out of the Waters. The Zone of Perpetual Rains. Torrential Rainbursts in the Zone of Single Rainy Seasons. Great Rainstorm in the Abyssinian Soudan. The River Indus. The Mighty Torrents of the Mountain Track. The Great Gorge at Iskardoh.

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Sudden Floods on the Upper Indus. The Indus as the Military Frontier of North Western India. Attock. Wild Scenery. Tremendous Currents and Floods. Kalabagh. The Indus Debouching into the Plains. Ancient Invasions of India and the Indus River. Invasion by Alexander the Great. By Tamerlane. By Nadir Shah. The Sack of Delhi. The Ancient Invasions Practically Unopposed. Modern Military Opinion as to the Value of the Indus Frontier. "India between two Fires." Influence thereon of the British Navy. The Plains Track of the Indus. The Indus during the Rains. The Punjab, the Land of The Five Rivers. Their Juncture with the Indus. Sir C. Napier's Description of the Impassable Character of the Indus. "Nullahs" issuing from the Indus. Battles of Miani and Dabo. The Embouchure of the Indus. Karachi. American Rivers. The Mississippi-Missouri. Valley Track of the Upper Mississippi. The Plains Track of the Lower Mississippi. Inundations. Delta and Bar of the Mississippi. Mississippi Steamers. Dangers of the Navigation. Snags. Mississippi Steamboat Accidents. Burning of "The Prairie Belle." The Mississippi Passes. Lake Ponchartrain. Mississippi Swamp Lands. Discovery of the Mississippi. Its Influence on the Naval Power of the United States. The Saint Lawrence. The Great Lakes. Niagara River. Navigation and Tides of the St. Lawrence. Quebec as a Great Fortress. Influence of Sea Power upon History. The Conquest of Canada. Panorama seen from the Ramparts of Quebec. The Falls of Montmorency. Ice upon the St. Lawrence. Break-up of the Ice. Sudden Transition from Winter to Spring. Estuary of the St. Lawrence. Mighty Cliffs of the Saguenay. Sea Mouth of the St. Lawrence. The Bird Rocks. The Banks of Newfoundland.

EACH of the great continents is drained by its own river systems. During the course of uncounted ages the rains have excavated these channels across the surface of the land, as a vent for the surplus waters on their descent to that great general reservoir, the ocean. It looks as if these mighty channels, which we are about to describe, had been constructed by a special design of The Great Architect of Nature for the rivers: but it is not so. This great work of construction was assigned to the rivers themselves. According to the law of gravitation they effected this by the constant flow of their current, continually eating into the plain, and wearing away the surface of the solid rock. In this great work of the water, an admir-

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able object lesson is conveyed to mankind, illustrating the truth of the old adage that "Perseverance will effect wonders," for with what seem to all appearance very small and inadequate resources, water alone has gradually excavated these wonderful channels of enormous length and magnitude which we call rivers.

Their courses, which are engineered with marvellous skill and cunning, have like their channels been automatically determined simply by the force of gravitation; wherever the lowest level was, there the water flowed, winding and turning as the contour of the ground required; ultimately by dint of constant labour it cut its way through every opposing obstacle, often literally for thousands of miles, until at last it effected its juncture with the ocean.

The course of every great river may be divided into three parts: (1) The Mountain Track; (2) The Valley Track; (3) The Plains Track; * to which for the main streams we may add a fourth, namely that highly important portion, from a commercial point of view, known as the estuary or tidal section, where the salt water mingles with the fresh. The mountain track will generally be represented, in extensive river systems, by torrents descending from the hills, whose turbulent course has been briefly noticed in the preceding section on great mountain regions. The valley track will be represented by the river, already perhaps grown into a stream of considerable magnitude, as it issues from the hills, and winds its way still tumbling and tossing through the highlands of the interior of the continent, where though its course is necessarily less turbulent than upon its first portion, it is still generally greatly obstructed by

* *Encycl. Brit.*, 9th edit., Vol. x., p. 275 (Article "Geology").

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rapids and other obstacles, which render it therefore of little account as a navigable stream. The plains track, on the contrary, is generally through a comparatively level country where the river flows in a wide, deep, and tranquil current, and this portion of its channel in a great river is very often navigable, sometimes for hundreds and occasionally even for thousands of miles. The river Amazon, for example, together with its tributaries, it is computed, affords free navigation over not less than 30,000 miles, all, or almost all of which lies within Brazilian territory. *

Then the estuary or tidal portion of a river, which is of such vast importance as a port of entry for ocean-going ships, is subject to a great variety of conditions, which differ very much in character on every river. In the first place there are of course the different falls of the river beds, and next there is the question of the rise and fall of the tides, which in some places is very great and in others comparatively small. Thus the Mersey, with an extreme tidal rise of 30 feet at its mouth, is only tidal for 46 miles; whilst the Seine, with a rise of 22 feet, is tidal for 91 miles; and the Scheldt, with a rise of only 13½ feet, is tidal up to Ghent, 105 miles. †

When a river enters the sea abruptly, the silt which is carried out by the current is sure to be driven back by the waves and to be deposited in obstructing barriers near its mouth, forming dangerous bars, on which the surf during storms beats with terrific violence; the entrance to such rivers in bad weather

* *Encycl. Brit.*, 9th edit., Vol. iv., p. 221 (Article "Brazil").

† *Encycl. Brit.*, 9th edit., Vol. xx., p. 576 (Article "River Engineering").

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is therefore full of perils for shipping. We may cite the mouth of the Columbia river, on the north-west coast of America, as a good instance of this kind; we were once nearly wrecked in making the entrance to this river: the vessel touched ground, the surf almost engulfed it, and would have quickly destroyed it, had she not floated off almost immediately, for though there was very little wind, a heavy swell came in from seaward.

"Mere description," says Commodore Wilkes, U.S.N., "can give little idea of the terrors of this bar. All who have seen it have spoken of the wildness of the scene, and the incessant roar of the waters, as one of the most fearful sights that can possibly meet the eye of a sailor." * In our time the only way was to cross the breakers well toward the southward end of the bar, and once these were safely passed, the noble river affords a secure and commodious anchorage for ships of the largest size, and is navigable by them for about 100 miles, up to the Cascades. According to a high authority, "The flood of the Columbia when at its height presents a magnificent spectacle, gliding past swiftly, but with majestic silence, bearing along gigantic forest trees, whose immense trunks appear as mere chips upon its waters." † All this is however changed for a scene of wild confusion when the bar is reached. Here a heavy swell from the almost boundless expanse of the Pacific Ocean, is nearly always coming in, even during the finest weather, which when met by the opposing current creates a commotion that must be seen to be realized.

* *Imperial Gazetteer*, Edited by S. W. Blackie, 1860, Vol. i., p. 726 (Article "Columbia River").

† *Ibid.*, Vol. i., p. 333.

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The best form for a river estuary is, when it enlarges gradually as it approaches the sea, affording free scope for the entrance of the tide, and promoting a regular flow of the waters. Estuaries of this form are said to be generally free from bad bars, * the channel being kept clear by the aid of the fresh water discharge, which being penned up by the flood tide, reinforces the ebb, and so produces an equilibrium. The Thames, the Severn, and the Scheldt, may be cited as examples of the latter form of estuary; but above all that of the great river St. Lawrence forms the noblest of all examples of this kind. The St. Lawrence has a clear channel for ships of the largest size for over 550 miles, as far as Montreal; and the tide ascends the river to lake St. Peters, a distance of nearly 500 miles. † Taking it as a whole the estuary of the St. Lawrence may be considered as the most perfect example of a great river embouchure in the world, but its obstruction by ice in winter-time constitutes a serious drawback.

On the other hand the river Ganges is an instance of a mighty stream losing itself in a swampy delta, traversed by an infinite number of intricate shifting channels, which render it almost inaccessible to shipping. The Indus is another river wholly inaccessible for seagoing ships from similar causes.

The embouchures of all the great rivers, however, exhibit each their own special peculiarities; these are endless in detail, so that it would be both tedious and unprofitable to dwell further upon this branch of our subject; but before proceeding to glance at what ap-

* *Encycl. Brit.*, 9th edit., vol. xx.. p. 576.

† Norie's *Navigation*, 21st edition 1877, p 352—("Tidal Tables.")

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pear to be the most noteworthy features of a few of the principal river systems, it is we think desirable to briefly consider the probable process of formation of a great river channel, in its geological sense.

A moment's reflection will be sufficient to convince any observant mind how vast must have been the changes which time has produced upon every river channel; as for instance, where the water has worn deep gorges for long distances through masses of solid rock. Let us endeavour to conceive what must have been the probable condition of such a river, in the earlier stages of its existence. Originally, there can be little doubt that as its waters descended from the highlands they must have encountered numerous obstructions, which barred their progress to the sea; that must have entailed the formation of more or less gigantic lakes at each of these points, where the waters were pent up until they filled the whole catchment basin to the rear of them, and finally overflowed the crest of the barrier: the stream would then have been free to descend on the opposite side, gradually eating its way through the obstruction, as it flowed. Most of us can doubtless recall numerous instances where we have ourselves seen such lakes, which still exist in the courses of streams; and where, if we view the matter aright, we can daily see them at their unceasing work of cutting through the obstructing barrier.

Visitors to the Upper Engadine in Switzerland will see a good example of this in the chain of lakes occupying the bed of that valley, which empty their surplus waters, proceeding from the melting snows, from one lake into the other, by the connecting torrents,

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until they pass over the falls into the rocky gorge below St. Moritz, and out into the lower levels beyond. This rock-cut gorge is a fine example of the excavating power of swiftly running water, and shows where the river has already burst its way through the high divide which originally existed at this point. Near its exit from this gorge it is joined by another stream proceeding from the Bernina chain, which as it passes below the village of Pontresina, affords a good though minor example of another form of channel, in the deep cañon with perpendicular walls which the stream has cut in the solid rock at that point. The visitor to these parts will however probably have had the opportunity of seeing the splendid example of the cañon on the Albula river, while crossing the pass of that name. The spot we refer to is situated just above the village of Alvaneu, where the road for more than a thousand feet is hewn or blasted out of the face of the cliff, with the torrent roaring at a depth of 500 or 600 feet below. * But enhanced as these European examples of rock gorges are by the undoubtedly beautiful scenery by which they are surrounded, when regarded as examples of the errosive force of water, or as specimens of great rock-worn river channels only, they of course fall very far behind other examples of the same kind which are to be seen in many other parts of the world, less well known to the British tourist. As a vast system of lakes forming mighty reservoirs in connection with a great river system, the world can show nothing at all to compare with the great lakes dividing Canada and the United States, which find their exit

* Murray's *Handbook for Switzerland*, Route 93—Coire to Samaden in the Engadine.

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to the sea by the river St. Lawrence. These great lakes form admirable examples of overflow reservoirs, such as we have spoken of. We here see a mighty river channel still in process of formation, and in ages yet to come, should the Niagara falls cut their way back through the rocky obstruction into softer strata, the world might yet see these great lakes much reduced in size, and portions of their beds converted into alluvial plains, such as we see many examples of throughout the world. Great level plains of this sort often excite the astonishment of beholders, and give rise to many surmises respecting their probable origin. In many cases we believe that they have been thus formed by the deposits of water, beneath which they have been submerged when they were the beds of immense lakes, at an earlier epoch of the world's existence. In some cases it may be that these waters may have been those of the ocean; but if so, the fact is generally made apparent by the discovery of marine shells and other remains of the ancient sea; but there are other notable cases, where for great depths below the present surface of the land the remains are all of *fresh water origin;* and that being so, is strong presumptive evidence of the former existence of some mighty lake, from whose waters these alluvial deposits were formed, throughout an epoch of geological time of whose magnitude the human mind can form no adequate idea, and in comparison with which the whole period of historical time is dwarfed into absolute insignificance. The time occupied in the formation of lacustrine deposits is immense. Mr. G. F. Richardson, formerly one of the staff of the British Museum, in regard to this matter says: "Lakes are ascertained to

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shoal up, or deposit sediment, in the proportion of only a foot in a century." *

In connection with this question of flat plains consisting of the alluvial deposits of fresh water, we deem it right to call attention to the geology of the more recent strata underlying the surface of the great plain of Northern India. It would ill become us however, to hazard any definite opinion upon so great a question as the means by which this mighty table-land was originally formed; at present there is not evidence to enable anyone to form a decided opinion about the matter, we shall therefore content ourselves with giving a brief outline of the facts which have been collected about it.

"It is (says the *Encyclopædia Britannica*) an alluvial deposit of sandy clay, on the surface of which nothing in the shape of a pebble can be found, except in the immediate vicinity of the hills." † According to the same authority, there is no evidence either for or against its having been laid out by the sea—"on the one side (it proceeds to point out) it is difficult to understand how so even a surface could have been produced otherwise than under the sea; while on the other there is a complete want of marine remains." § The marine remains, we venture to remark, are confined to the older tertiary strata, which lie far below the present level of these great plains; as is shown by these rocks appearing, deflected upwards, in the way we have already described in our preceding section on Mountain Ranges, with such fossils in them, near

* Richardson's *Geology and its Associate Sciences*, 2nd edition, p. 86.
† *Encyclop. Brit.*, 9th edit., Vol. xi., p. 827 (Article "Himalayas").
§ *Ibid.*

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the foot of the higher Himalayas; but the remains found in the beds *overlying* these tertiary strata, and nearer to but still beneath the surface of the plain, are terrestrial and not marine. Also we venture to assert, that the flat surface of the plains might have been produced under fresh water, as well as under the sea.

The question then arises, did these great plains once form the bed of a gigantic lake? It is obvious that such a lake need not necessarily have been very deep to form this plain, but merely that its surface should have been submerged beneath the water. Now, "the great plain of Northern India stretches with an almost unbroken surface along the foot of the Himalayas, from the Upper Indus to the head of the Delta of the Ganges. Its area is about 500,000 square miles. It nowhere rises to more than 1000 feet above sea-level, and to the unassisted eye appears a perfectly dead flat." *

All those who have travelled or resided in India will doubtless retain a very vivid recollection of the trying heat and dreary monotony of these vast and interminable plains; where day after day, and week after week, the wayfarer used to toil painfully along before the days of railways; and where each day's journey was but a repetition of that of the previous day. Since then, the railways have reduced the tedium of this great journey to a minimum; and yet still, as we know, for days we can go ahead on the railways, and see plains, and nothing but plains, of this apparently dead level character. We however found that very little of the ground was really level; nevertheless the

* *Encyclop. Brit.*, 9th edit., Vol. xi., p. 823.

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gradients are often very slight. On the Indian lines the gradients are generally clearly marked on boards, placed at intervals along the railways, so that the traveller can see for himself what they are. We shall quote a few instances from our own notes to give the reader a more exact idea of this. Then, as regards the levels of lands obviously newly laid out by the sediment of water: it is unnecessary to go further than to the sea shore, where extensive sand or mud flats are exposed at low water. Here we shall find that it is all laid out in flat inclines, exactly in this way, as proved by the water all running off to seawards as the tide recedes. So also on the Indian plains and railways these inclines are clearly shown. On a very level section of the Rajputana-Malwa Railway * we made careful note of some of these, and found gradients varying from 1 in 300 up to 1 in 750 very common. Near Rawari we observed gradients of 1 in 1000; at the 290th mile post one of 1 in 1666, and even one of 1 in 2000 near Rawari Junction; but the bits marked "level" were comparatively rare, and also were always short lengths, wherever they did occur.

Now the object of entering into these technicalities is to impress the great improbability of such a country being laid down by any other natural agency, except that of *water* in a state of rest. Assuming for the sake of argument that these flats *were* levelled by the deposit of still water, like that of a lake, it is just in the condition in which we might have expected to find it. If it should be so, that the great plain of Northern India was in bygone ages (as we believe to be probable)

* Or Northern Section of the Bombay, Baroda, and Central Indian Railway.

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formed by the deposits of some gigantic lagoon: the tendency would be, as we have shown, for this mighty sheet of water gradually to evacuate itself, by its overflow cutting through whatever it was that obstructed its outfall. It can be, we think, very conclusively shown that such is the actual tendency of every other existing lake, and the margins of most of the extensive inland sheets of water generally show evident traces of their own levels having been lowered, in this manner, throughout the course of time. The process of cutting through obstructions must however, in all cases be a very gradual one; and of course its effect would be to lower the level of the lake by degrees, as the operation proceeded, until the waters in the end became evacuated altogether, leaving the bed of the ancient lake, laid out by the retreating waters in long and very gradual slopes, very much as we now see it upon the plain of Northern India.

Opinions of course may differ as to how the mighty work of levelling off the surface of this great plain was effected. It *looks*, as we have said, as if it had been the sea. But that is merely because people find it perhaps harder to believe in the existence of so great a lake; but the fact to which attention has already been called, that no marine remains appear in the surface strata, but only those of terrestrial origin, is very significant. These facts are not only conclusively shown by the examination of the surface deposits themselves, when they have been laid open, in ravines, etc., but also by artificial borings penetrating to a considerable depth beneath. We may quote instances of this in a well sunk 481 feet deep at Fort William, Calcutta, during the years 1834 to 1840, which passed

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through sand and clay all the way. * Also at Umballa, an important cantonment on the line from Delhi to Simla, at an altitude of 905 feet above sea-level, and twenty miles from the base of the mountains; a depth of 701 feet was here attained with practically a like result; that is to say, the borings passed through sand, but, in this case mostly beds of clay. †

The reader will here see the great thickness of these apparently (according to the *Encyclop. Britannica*) fresh water beds; and the slow rate at which such are deposited, which (according to Mr. Richardson) does not exceed about one foot per century, supplies a wonderful piece of circumstantial evidence as to the great antiquity of the earth, especially when we bear in mind that at a still greater, but at present undetermined depth, below these fresh water strata, we reach the tertiary rocks, which are on the contrary full of marine remains, showing that *before* the great lake (if there was one) the ancient sea had rolled for uncounted ages above the Indian plain. Now, these tertiary rocks are in all probability some thousands of feet in thickness, and they were deposited by this sea at a rate which according to competent geologists, little, if at all, exceeds the rate of accumulation from fresh water deposits, § as stated above. But inasmuch as these strata have been subjected to enormous pressure, it follows that one foot (of chalk, for instance) would represent a vastly greater

* See *Manual of the Geology of India*, compiled from observations of the Geological Survey Department, by H. B. Medlicott, Superintendent of that department, and W. T. Blandford, F.R.S.; Calcutta, 1879. Part i., Chap. xvii., p. 399.

† *Ibid.*, Chap. xviii., p. 401. (NB.—At the pages indicated a complete list of the various beds, their thickness, nature, colour, etc., are all specifically stated).

§ See Richardson's *Geology and its Associate Sciences*, 2nd edit., p. 86.

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amount of deposit, than one foot of recent alluvial mud. If we said one foot of chalk represented six feet of mud, or six centuries of deposit, it is probable that we should rather overstate than understate the facts.

This is as far as we feel justified in carrying the question of the supposed origin of the great plain of Northern India—and we must leave our readers to draw their own conclusions from what we have stated. At the same time we must remind them that further to the northward, in Central Asia, there are other great plains, whose vast extent dwarfs the size of the Indian plain entirely into insignificance. Similar questions might arise with regard to *their* formation also, but comparatively little is known about them at the present time. They represent our „Region of the Great Plains" upon the Asiatic continent, and are generally known as "the steppes."

Listen for a moment to a descriptive outline of them, from the pen of Mr. J. G. Kohl, culled from a translation of the second volume of his great work on "Russia:"

"The Steppes extend" (he says) "from the borders of Hungary to those of China. They constitute an almost uninterrupted plain, covered in spring and summer by a luxuriant herbage, and in winter by drifting snows. The slight undulations rarely seem to assume the character of hills. The most singular characteristic is the total absence of trees. Countless herds of cattle roam over these noble pasture grounds, on which a calf, born at the foot of the great wall of China, might eat its way along, till it arrived a well-fattened ox on the banks of the Dneister, to figure at the Odessa markets." *

* *Russia*, by J. G. Kohl, 1 Vol. 8vo., London, 1844. (N.B.—A translated digest of 8 or 9 vols. by this author, of which vol. ii. relates mostly to the Steppe country).

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According to Michelet the steppes of Central Asia have an estimated area of about 4½ millions of square miles, and are mostly elevated table-lands raised high above the sea-level, and drained by means of ravines, cut by the streams in time of flood. These ravines, according to Kohl, are seldom less than from 100 to 150 feet in depth, with precipitous banks; they therefore form great obstructions to travel; moreover in winter time, these places fill with the drifting snows, and then become exceedingly dangerous to anyone who is not intimately acquainted with the country, men and cattle being often buried by falling into them, and their fate only ascertained when the melting of the snows leaves their bodies exposed. * The monotonous character of these boundless plains far exceeds that of the Indian plain, which is almost always adorned by clumps of fine trees and dotted over with native farms and villages, or other objects to attract the eye, whereas on the steppes, there is "not a tree, not a hill, to break the monotony of the landscape, through which a well-mounted rider may gallop for hundreds of leagues, and scarcely see an object to make him conscious that he has quitted the spot from whence he started." †

When our Indian friends therefore enlarge upon the vastness and monotony of the plains of Hindustan, let them bear in mind that they are as nothing compared with the still greater plain which occupies the heart of Central Asia. Here the wilderness claims as her own a mighty expanse nine or ten times as large, upon which there is hardly a single object to attract

* *Russia*, by J. G. Kohl.
† *Ibid.*

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the eye, and where the stifling heat and dust of summer alternates with the blinding snow drifts and the rigours of an absolutely arctic winter.

The paramount influence which water has exercised in the architecture of Nature can hardly be overestimated. From the dawn of creation, its mighty operations have never been suspended even for an instant. From age to age it has been gradually levelling down the mountains, excavating the valleys, spreading out the plains and table-lands; while its march towards the ocean is as irresistible as the forward movement of time itself.

We have done our feeble endeavour to briefly sketch the formation of lakes upon the upper courses of river systems, and to show how they form natural reservoirs for the water, which in the end overflows the basin, and (except in those very rare instances, such as the Dead Sea, and the Caspian Sea, where the inflow is balanced by evaporation) finally makes its exit to the sea.

These operations, as we believe, form the groundwork upon which every great river system is built up—the original form of the river course having probably been in most cases a chain of lakes standing at different levels and joined by streams. As time goes on, the second stage in the process follows: the current has now cut through the obstructions, and when that is accomplished, the lake above is emptied, leaving a flat alluvial plain in its place, with a river meandering through its former bed until the water passes out through the more or less deep gorge which has been cut through the divide; where this has been worn through rock, a gorge with more or less perpendicular sides probably

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remains, in the form of a cañon, as a testimony to the ages of persistent work by which this has been effected; if on the other hand it was through softer strata, such as gravel or clay, slides have occurred, and masses of fallen stuff have been precipitated into the river. This material the giant labourer makes short work of, and quickly shovels it away, and removes it in the form of sand, gravel, or mud, which it spreads over the first convenient lowlands beneath. It is in this way that many alluvial flats are formed. The gorge will thus gradually have assumed the form of a valley with sloping sides, through which the river flows. In the Upper Mississippi and other great rivers, such a valley will sometimes be several miles in width to the bluffs which enclose it, through the channel having changed its course from time to time.

The carrying power of water is as we know enormous. In our preceding section we gave some details concerning the immense blocks of granite, some of them fully ten feet in diameter, that have been carried down for many miles by the torrent known as the great Rangit, which flows through the gorges of the Himalaya Mountains of Sikkim, and bursts its way into the Indian plains by the valley that leads down from the Darjeeling plateau.

We must not lose sight of the fact that the weight of every gallon of standing water is 8 lbs.: consequently when a heavy fluid of this density is confined within narrow boundaries by enclosing walls of rock, and the current is propelled by gravitation down a steep incline, there is literally no limit to what water may not be capable of doing.

A wonderful example of such a torrent can be seen

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at Imatra in Finland, within easy reach from St. Petersburg. It is enclosed just in this way, between rocky walls of no great height, and the visitor can approach without difficulty to the very edge of the chasm; so that he can see the whole thing at his leisure, while occupying comfortable quarters in the excellent hotel, which has been established close at hand, we believe by a Frenchman, from whence fine fishing can be enjoyed in the midst of charming scenery.

Here, perhaps almost more than anywhere else, the impression conveyed to the mind while watching the frantic rush of the raging torrent, is that of being in the presence of an absolutely resistless power; and in still weather the sullen roar of its waters is audible for considerable distances through the surrounding forests." *

In the case of torrents situated in ravines of great mountain chains, such for instance as the Himalayas, many even wilder scenes of furious waters may doubtless be witnessed, whose dull thunder, especially by night, resounds with awe-inspiring grandeur among the surrounding hills; but access to points of vantage where a good view of them can be had, in many cases proves both difficult and dangerous. Many of these mighty chasms (each one of which, it is impossible to doubt, has been mainly or altogether excavated by the work of water) are thousands of feet in depth; with more or less precipitous sides, which can only be descended or ascended by a great expenditure of physical labour, combined very often with a certain amount of risk; and the heights along which the paths and other lines

* A common experiment to give an idea of the force of this torrent is to cast an empty barrel into the stream, which is in general instantly torn to pieces by the raging waters.

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of communication created by human agency, are generally situated, are often so great that the eye frequently fails to fathom their gloomy depths, and one looks down into what appears to be a bottomless pit, when the sun is not shining directly into them. In these cases the only indication of the existence of the torrent is the noise of its waters, heard ascending from the abyss beneath; occasionally however, wonderful views of these great ravines are obtained, when they happen to be brilliantly lit up by sunlight. They are then seen extending for miles, until lost in the distance, with precipices thrown out into brilliant relief and their slopes generally covered from top to bottom with luxuriant forest growths. The bottoms of these ravines are almost always occupied by streams, and the torrent can then be seen, apparently (and sometimes actually), a mile or more in vertical depth below: its waters white with foam, dashing along its rocky bed. Near Darjeeling for instance, such a ravine may be seen, nearly seven thousand feet deep, that is in other words upwards of a mile and a quarter below the spectator's feet.

In our preceding section we mentioned the wonderful gorge of the Indus near Iskardoh in Little Thibet, where the river bursts through the western ranges of the Himalayas, which is stated on good authority, by several writers, to be 14,000 feet deep,* that is in other words, but little less than $2\frac{3}{4}$ miles. The sources of the Indus, however, like those of many other great rivers, still continue more or less a mystery, and take their rise in unknown solitudes, in about Lat. 32° N., Long. 81° E., at a great altitude above sea-level. This uncertainty with regard to the sources of great rivers

* *Encyclop. Brit.*, 9th edition, Vol. x., p. 68 (Article "River Indus").

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is a remarkable fact, common to almost the whole of them, and one which shows perhaps better than anything else how large a portion of the earth's surface is even yet occupied by the wilderness. It would be too long to go over them all in detail; but the observation may be said to apply to the sources of nearly all the great rivers of Asia, Africa, South America, and Australia; and even in North America it is only of quite recent years, that the restless spirit of adventure which characterizes the American people has succeeded in fixing the approximate sources of the Mississippi, the Missouri, the Columbia, the St. Lawrence (the head waters thereof, beyond the lakes, that is), and those of others of the principal streams of North America. Some of these are even now very imperfectly known, and their position, as marked upon the maps, must still be regarded merely as approximately correct.

The explanation of these curious facts is not far to seek; the habitations of man, or of civilized man at all events, are almost invariably for commercial convenience located at first near the margins of the seas; and as the country adjacent to the coasts becomes occupied, the human tide rolls onwards towards the highlands of the interior, where all great rivers take their rise, often amid inaccessible mountains, or among dense primeval forests or morasses. Most of the North American and the Asiatic rivers are examples of the former; and those of South America and Africa of the latter class of streams; and it is from the summit of its principal divide, or watershed, that the great rivers of continents mostly take their rise; first as rivulets, turbulent and noisy, in their infantile gambols; but eventually issuing to the ocean as swelling tides, bearing the

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fleets and commerce of many nations upon their broad and ample bosom.

Here the river reaches the close of its existence; for like everything else on earth, rivers live and die. They run their appointed courses, and are then finally blotted out of existence, and absorbed in that eternity of waters called the ocean. This last stage of their existence may be briefly told in the figurative language of the Arab storyteller, describing the close of his hero's career: "They departed, and went, even unto the mercy of Allah; and they became as though they had never been."

The carrying powers of water, by which great masses of stone are removed for long distances, by mountain torrents, are as we have said exceedingly remarkable; but the same power when exercised by an ordinary river current along its plains track, is if possible still more remarkable.

Vast, and altogether apparently incredible quantities of matter, are thus continually being carried by rivers —first from the highlands down into the plains, and finally from the plains into the ocean. This matter may be roughly said to consist of: (1) Boulders, or water-worn pebbles of considerable size; — (2) Gravel, or debris of rock reduced to smaller fragments, also much water-worn; — (3) Sand, or the same reduced to powder; — (4) Mud, or silt, consisting of clay and earthy matters, more or less held in mechanical solution by the water; — (5) Mineral salts or organic matters, held in *chemical* solution, and generally for the most part existing in invisible form in the water.

The larger boulders are generally confined to those portions of the river where the water runs swiftly, such

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as in mountain torrents, or other places where numerous rapids occur: very little small stuff is ever seen in the dry channels of such streams; but water which flows with much less velocity is still capable of moving the smaller sizes of such stones, for it must be borne in mind that the weight of objects, such as stones, etc., becomes considerably less in water than they are when out of it, because of the much greater density of water than of air. The supporting power of water is therefore infinitely greater, as the swimmer finds when he maintains himself afloat upon its surface, much as a bird does in the air. According to Professor Huxley, "if a stone be twice as heavy as an equal bulk of water, it will lose half its weight when immersed in it. If three times as heavy, one third; if four times as heavy, one fourth, and so on." * Then as regards the actual power of streams in transporting such objects from place to place, Professor Huxley lends the weight of his authority to the statement, that a stream flowing at the rate of 36 inches per second (= 3600 yards an hour, 3520 yards being two miles), "can transport pebbles as large as hen's eggs;" "if at 12 inches per second, it can sweep away fine gravel," † and "at the rate of 6 inches per second" (= 600 yards per hour), "it has power to carry off fine sand." § Of course, with very little current, a stream can still bear along mud, and other matters mingled with its waters in a state of semi-solution.

* *Physiography*, by Professor Huxley, F.R.S., 1887, p. 133.

† *Ibid.*, p. 133.—No doubt the professor here means to indicate that pebbles of this size are *moveable* merely by a stream running at this rate, and are thus rolled slowly onward by it.

§ *Ibid.*, p. 133.

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lastly, it is the property of standing waters to hold in solution, without deposit, matters held in *chemical* solution, as for instance, say a certain quantity of common salt. Chemistry, however, teaches us, that water will only take up a certain fixed quantity of such matters. When the maximum percentage is thus reached, it is technically said to contain a "saturated solution," and then, the moment evaporation sets in, so that a portion of the water is abstracted as vapour, "precipitation" takes place: that is to say the surplus matter falls to the bottom in the form of a *sediment*. A common illustration of this is seen in the sediment deposited on a kettle in which water has been boiled, which very generally consists principally of carbonate of lime; but the same result, we need hardly say, will follow when water evaporates, after standing for a certain length of time in a pond or lake, or in a water jug. From the clearest drinking water lime will often be deposited in this way upon the glass, to which it adheres so firmly that it is sometimes very hard to remove; and when the water contains vegetable or other organic matter, a dark coloured sediment will be observed at the bottom of the vessel. The reader will perhaps pardon our going into details of this technical nature, for as we shall proceed to show, a great deal depends upon them, these matters being of vast importance in the economy of Nature.

The amount of solid material carried out to sea by a great river in the form of silt, during the course of a single year, would hardly be credited by those who have not made such subjects a special study. Let us take the case of the Thames, a very minor river, with a drainage area of only 6,000 square miles, as an

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instance in point. We select the Thames, because for centuries past it has been more closely watched, and all its phenomena have been subjected to more minute and accurate investigation than those of perhaps any other river. Now, the amount of sediment discharged by the Thames, annually, is estimated at 1,865,903 cubic feet,* *besides* matters washed away in solution. This process of gradually washing away large quantities of solid matter from the land into the sea, is known as that of "Denudation;" it is a work, as we have more than once observed, always in operation, which is mainly carried on under two forms: "Fluviatile denudation," which is the work of rivers; and "Pluvial denudation," which is the work of rains. The other minor forms may at present be left out of account. It must be obvious that these processes, thus continuously going on, must, in course of time, inevitably tend to profoundly modify the extent and condition of the habitable surface of the globe; and in connection with their probable results as regards our own country, Professor Huxley, in his work on Physiography, quotes an opinion of Professor Geikie, to the effect that, after taking into account, as far as possible, the whole quantity of matter which from every cause is annually carried into the sea from the surface of the British Islands, the latter "has calculated that at the present rate of denudation, it would require about five and a half million of years to reduce them to the level of the sea." †

But concurrently with the process of Denudation,

* *Modern Denudation*, by Professor A. Geikie. See transactions of Geological Society of Glasgow, Vol. iii., p. 153.

† *Physiography*, by Professor R. H. Huxley, F.R.S., 1887, p. 149.

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or pulling down, there is also another process in constant operation, namely that of building up of new lands beneath the bed of the sea. As the general level of the land becomes reduced, of course the bed of the sea becomes proportionately raised by the process of sedimentary deposit, the tendency being to create vast marshy swamps along and in advance of the present coast lines; many extensive areas of such lands already exist in almost every part of the world; but it is near the mouths of some of the great rivers that this operation may be seen in active progress; in several of these cases the sediment brought down by their waters, for ages past, has accumulated, and formed large, flat, low-lying "Deltas" at the point where they enter the sea, so called from their resemblance in shape to the Greek capital D or "delta," marked "△" in that language.

The deltas of the Nile, the Ganges, and the Amazon, form leading instances in point, large territories of this sort having formed at the mouths of each of these rivers. So immensely extensive is the delta at the embouchure of the Amazon, that considerable difference of opinion has arisen among geographers as to whether it ought to be regarded as such at all or not; if, however, this term is to be construed as meaning, a more or less delta-shaped alluvial flat, deposited by the river at the point of juncture of the fresh water with the salt, then the vastness of its size cannot invalidate its title to be considered a "delta." Its shape, however, has in this instance been considerably modified by tributary streams and changes in the channels of these rivers; also it evidently includes some islands, which existed at a former epoch off this coast, and which

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formed a nucleus round which the alluvial lands at the mouth of the Amazon have subsequently formed.

Of such vast size, however, is this enormous river that it almost rather represents an arm of the sea than a river in the ordinary acceptation of the term. Mere words are powerless to convey an adequate conception of its magnitude, without embarking in panegyrics and high-flown description which might appear to savour of exaggeration; in every respect it is incomparably the largest river in the world, though perhaps not the longest; and gazing upon its mighty flood, awe-stricken beholders have sometimes been prompted to call it "The Mediterranean of South America." * The Amazon in fact, forms a species of central catchment basin for the reception of the waters of a number of gigantic tributaries, which flow into it from both sides; almost all of which are themselves navigable for many hundreds and even thousands of miles. A single sentence will convey a better idea of the magnitude of this mighty river system, and will probably appeal more forcibly to the mind, than the longest verbal description, when we say that it affords free navigation "over not less than 30,000 miles," † almost all of which lies within Brazilian territory.

To this we may add that the area drained by the Amazon and its tributaries is estimated to be not less than two and a half millions of square miles: representing a territory more than one third the extent of the whole surface of South America. While at its junction with the ocean, its main mouth is "50 miles

* See for instance *Encyclop. Brit.*, 9th Edit., Vol. iv., p. 221 (Article "Brazil").

† *Encyclop. Brit.*, 9th Edit., Vol. iv., p. 221.

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wide, and the whole delta nearly 200 miles across, from shore to shore." * The depth of its waters is also very great, and "in some places exceeds 50 fathoms" † (=300 feet); its mighty flood continually moving steadily seawards, with swift and silent majesty, until it mingles with the ocean—where it stains the waters "for 600 miles from its mouth" §—the river current being distinctly perceptible in the ocean for more than 200 miles from the shore." **

We have endeavoured thus briefly to convey some idea of the extent and magnitude of this great river system, and shall now supplement it with a few words respecting its principal tributaries. The head stream is either the "Ucayle" or the "Marañon," both large rivers, and the Amazon is navigable for vessels of the largest size up to the confluence of these rivers, at a point some 2,200 miles from the sea. The following are a few of its principal tributaries, most of them, as the reader will see, being as we have said of enormous magnitude. From the north there are: the Napo and the Putumayo, each about 700 miles long; the Yapura, 1000 miles; the Rio Negro, 1400 miles; and others of less importance. From the south: the Madeira of nearly 2000 miles; the Tapayos, 1200 miles; the Xingu 1300 miles; the Tocantino (an immense river), 1200 miles; and many others. †† Many of these rivers are very imperfectly known, and later information seems to show that even these large dimensions are in some cases considerably below the

* *Encyclop. Brit.*, 9th Edit., Vol. i., p. 654 (Article "Amazon").
† *Ibid.*
§ *Brazil, the Amazon and the Coast*, by Herbert H. Smith, 1880, p. 3.
** *Encyclop. Brit.*, 9th Edit., Vol. i., p. 654 (Article "Amazon").
†† *Ibid.*

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real figure. Mr. Herbert H. Smith for instance, an intelligent American traveller and observer, states that of the three last named rivers (which are all of them clear water streams), the Tocantino is considerably the largest in size, being "1600 miles (in length) by the Araguaya branch, and nearly 1500 by what is considered as the Tocantino proper." * And in his closing chapter on The Tributaries of the Amazon, Mr. Smith gives a number of details, showing that there are quite a number of other rivers whose size might entitle them to be added to the above list, did time and space permit.

Our object however is to sketch merely an outline of the leading features of this great system, without wearying the reader by a mass of technical details, for which we must refer those desirous of further information to works specially devoted to a description of the Amazon region.

Another great river system, with a delta second in size only to that of the Amazon, is the Ganges, which is joined at Goalundo, near the head of this delta, by the Brahmaputra, another immense river, coming from the eastward to mingle its waters with those of the sacred Ganges, before their united stream enters the Bay of Bengal, whose billows are stained for hundreds of square miles by its muddy waters.

One of the wildest districts in India is this great territory of swamps and lagoons, known as the "Sundarbans," which stretch along the seaward face of this delta, between the mouths of the Hooghly and the Megna, local names given to two of the principal streams which issue from it.

* *Brazil, the Amazon and the Coast*, by Herbert H. Smith, 1880, p. 590.

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This immense river system is however unfortunately split up near its mouth into an enormous number of channels, which find their exit to the sea through the mazes of the Sundarbans, a region of swamps and fevers, presenting in many places the aspect of an impenetrable thicket, choked with masses of bamboos and other gigantic reeds and grasses, mingled with bush forest. The Sundarbans are still full of tigers and other heavy game of every kind, which the impassable nature of the country, and its unhealthy character, render secure from the pursuit of sportsmen; all sorts of curious stories are current in Calcutta as to adventures with tigers, etc., met with by persons passing in boats along this complicated labyrinth of streams; a good many of which are doubtless founded on fact, whilst others are evidently exaggerations, or perhaps altogether fictitious. Even steamers are not always respected by these animals, as Mr. G. P. Sanderson (late of the Government "Kheddah" or Elephant-Catching establishment, a high authority on Indian sporting matters), quotes an instance of a tiger boarding a steamer at night, while it was plying from Goalundo to Dakka.* It is probable that the tiger may have been seeking rest during a long swim, and mistook the boat for an island or rock. Mr. Sanderson however mentions having heard of other similar cases, of these animals getting into native boats, and stories of a similar kind are common in Calcutta.

The whole of this country, extending from the sea up to Dakka and Goalundo, is of a similar character, consisting of vast low-lying alluvial flats, a great deal of which is under water during the rainy season which

* *Thirteen Years among the Wild Beasts of India*, by G. P. Sanderson, 2nd edit., p. 123.

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lasts from June to October, the cultivated portions of it being then covered with crops of rice. Its very flat nature may be perhaps better understood, when we say that Dakka, though situated about 100 miles from the sea, is not more than ten feet above tide level. *

The influence of the tides therefore ascends from the Bay of Bengal for an immense distance up country. Their vertical rise during spring tides, at Sangor island at the mouth of the Hooghly, is 12 feet † and their ebb and flow keep all the rivers throughout the delta in a constant state of agitation, banking up the water at one period of the day, and causing it to race with dangerous velocity during the period of the ebb. During the rainy season these conditions are of course greatly intensified by the tremendous floods which then pour down the Ganges and Brahmaputra. The stream at these times comes tearing along with uncontrollable fury, almost with the impetuosity of a mill race, and frequently runs with a speed of eight or nine miles per hour, so that nothing but a powerfully engined steamboat can make head against it.

It is therefore evident that when exceptional causes combine to create an unwonted commotion, these restless and dangerous waters assume a most destructive character. Near Dakka, the action of the river has played particular havoc with the country, the whole river system having here become completely changed during the present century; and this town, once the ancient capital of Bengal, is now cut off from the

* See Murray's *Handbook for India and Ceylon*, 1892, p. 268—Route 20B.

† Norie's *Navigation*, 21st edit., Table lvii., p. 856.

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province by a vast body of water, difficult and often dangerous to navigate in small craft. *

Also, at the confluence of the Brahmaputra with the Ganges, near Goalundo, a point quite 140 miles from the sea, the destructive energy of the stream has been particularly manifested. During the rainy season the river here forms a very large body of water several miles across, and the influence of the tides ascends for many miles beyond this station, which is noted for the uncontrollable violence of its currents. Everything that engineering skill could do to control them has proved ineffectual; the river banks still keep constantly changing, and everything that has been built there has been destroyed. Goalundo Ghat, the terminus of the East Bengal Railway, has in consequence now no permanent buildings. Up to 1875, the Goalundo station stood upon a massive embankment, protected by masonry spurs running out into the river. About £130,000 had been spent upon these works, but in August of that year the whole was swept away by the flood, and deep water now covers their site. A new terminus has since had to be constructed two miles from the former river bank. † These facts will give the reader some idea of the irresistible power of the Gangetic floods and tide rips, before which the puny efforts of man are effaced as a child rubs out a mark made upon a slate.

The tremendous violence and rapidity of the stream is however not a little remarkable, when we consider the almost dead flat nature of the country. For instance,

* Murray's *Handbook for India and Ceylon*, 1892, p. 267.

† *Imperial Gazetteer of India*, by Sir W. W. Hunter, Vol. v., p. 110.

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the average fall of the river bed of the Ganges, from Benares to Calcutta, a distance of 661 miles, is only from four to five inches per mile; and from thence to the sea, via the Hooghly, a further distance of 90 miles, it is only from one to two inches per mile. *

It is much the same with all the other streams that flow through the delta; yet such is the momentum created by the pressure of the vast head of water pouring down from up country during the rains, that nothing is able to withstand it. The Hooghly for instance, near Calcutta, is said to have at times been known to rush along with a velocity of as much as ten, and even twelve miles an hour.

This furious current is created not only by the ebb of the tide, but by the stupendous weight of an immense water area, gravitating down from the interior, which at these times more closely represents an extensive arm of an inland sea than an ordinary river channel. Soon after passing Barackpore, for example, which is 14 miles by river above Calcutta, the waters in the rainy season have no visible bounds. †

Throughout their courses rivers of themselves in fact, represent so many sections of an inclined plain, where the current compressed between enclosing banks on either side, is only retarded from acquiring continually increasing momentum by the consequent constriction of the stream, powerfully aided by the obstacles it encounters in the convex bends of its course, which act as so many steps in a fish ladder in creating a back water. In this way it has been proved by repeated

* *Encyclop. Brit.*, 9th edit., Vol. x., p. 68 (Article "Ganges").

† See *Picturesque Tour in India along the Rivers Ganges and Jumna*, by Lieut. Colonel Charles R. Forrest of H.M.'s Staff in Bengal, 1824, p. 129.

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experiments that the back-water created by the influence of the tides will extend up a river, for a considerable distance beyond the actual limits of their high water level: the water assuming, as we have said, more or less the condition of an inclined plain; a series of recent observations made by the French engineers on the river Rhône, seem to have placed this fact almost beyond question. The proverb that "water will always find its own level," must therefore be received with reservations, as only true in part. Strictly speaking for instance, the cross section of river currents probably always assume more or less the form of a curve, convex in the centre; and in rapids this uprising of the water in midstream is sometimes quite visible to the eye. Then as regards the ocean (our nearest approach to a true plane surface)—this also as we know, visibly follows the arc of the earth's circumference (this is something about 1 in 2437), and in fact, actually does form a liquid circle engirdling the globe. The familiar figure of ships seen at sea, hull down below the horizon, is of course the result of this curvature, which amounts to about 2 feet 2 inches in the mile: an object the height of a man is thus hidden from the eye, at sea-level, at a distance of about $2\frac{8}{9}$ miles.

The immense rise of the Gangetic floods, which overspread a vast area of land, not only alters largely the level of the water, but also removes those natural impediments to the current above alluded to; therefore, as the level of the Bay of Bengal remains constant, the seaward end of its course becomes transformed into rapids of a highly dangerous character.

Thus the Hooghly, one of its principal branches,

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which as everybody knows forms the port of entry for shipping, and upon whose banks Calcutta, the capital of India and the seat of the Viceregal Government, is located, is often so difficult and dangerous of approach for vessels, that the prudence of abandoning it altogether, as a seaport, has for some time past been seriously considered.

The proposal is to remove the port to Diamond Harbour, some 30 miles further down the river, which though still a bad port is yet better than Calcutta.

The Hooghly is not only subject to cyclones of the most dangerous character, concerning which we shall have more to say presently, but on account of its shifting sands and impetuous current it can only be navigated by daylight; great delays are thus caused to vessels. As an instance we may state that quite recently we were ourselves detained for nearly three days, on board a P. & O. steamer in this way, between the mouth of this river and Calcutta, in doing a distance of only 90 miles. The first day we arrived off the mouth of the Hooghly, and the tide being low, were obliged to anchor near the lightship. Here we remained idly floating, out of sight of land, till the afternoon of the following day, before the tide suited to enter the river. Want of water again obliged us to anchor for the night at Diamond Harbour, after doing only about four hours steaming; and it was only on the third day that we reached Calcutta. These details will give the reader some idea of the serious impediments which adverse conditions may produce at the mouth of one of the most important river systems in the world.

The three principal obstructions to tidal rivers are: (1) a bar; (2) a shifting channel; and (3) inadequacy of

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depth. Human ingenuity has however been successful in many cases in greatly ameliorating the navigation of river estuaries, by means of engineering works, some of them being of great magnitude and carried out at enormous cost. But upon a vast river like the Ganges, and its branch channel the Hooghly, the puny efforts of man are brought to naught; the tremendous floods which frequently assume the character of a rapid, sweep away everything in their course. The largest ship, touching the ground, is at such times instantly capsized, and in a few moments disappears from view for ever. The three methods that are usually resorted to for the improvement of rivers are: (1) jetties; (2) training walls; and (3) dredging. In a river like the Hooghly these expedients are of little or no avail, large banks of shifting sand often forming in its channel in a few hours, where there was previously deep water. With a channel thus changing from day to day, and almost from hour to hour, great difficulties naturally arise; and it is only by being constantly on the river and closely watching the set of the current and the changes which are in operation, that a pilot can hope to bring vessels up in safety. Even then, on rivers like the Hooghly, terrible accidents are sure to occur from time to time. In order to give an idea of what the water can do, during flood time, it may be of interest to mention a few of the principal fatalities which have recently taken place on this river. The seasons when it is most dangerous are April and May, and again in August and September, as it is at these times that the floods are strongest. Thus on April 22, 1868, the "*Ethel*" dragged its anchor near the James and Mary shoal, and falling foul of the

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"*Agamemnon*," both vessels took the ground and were rolled over by the tide; and in four hours not a vestige of either ship was to be seen, and many of the crews of both ships were drowned. * On August 11, 1877, the ship "*County of Stirling*," carrying 1444 tons of wheat, grounded on the Falta Sand, a little to the north of the James and Mary shoal, and was literally turned upside down; she disappeared in eight minutes and five men were lost. On September 28, 1878, the steamer "*Queen Anne*," with 2400 tons of general cargo, grounded on the Falta Sands, and capsized in two minutes; the vessel and cargo were a total loss, and six persons were drowned. There were 78 persons on board, but the rest were saved by clinging to the ship's bottom, until rescued by a steam-tug. † On October 21, 1887, the British India S. N. Co.'s steamer "*Arcot*," 1782 tons, struck while crossing the Muckraputty Sands outside the mouth of the Hooghly, and at once capsized, but crew and passengers with the exception of five persons were saved. § And again August 26, 1892, the Anchor Line steamer "*Anglia*" capsized in a similar way and fifteen of the crew were drowned. **

The circumstances connected with this last case were particularly dreadful and created great horror in Calcutta, where we often heard the matter discussed during our recent visit to that city. But as the details we heard may have been exaggerated and coloured by the excited fancy of the people there, we forbear to repeat what was currently reported, and shall merely quote from

* See Murray's *Handbook for the Bengal Presidency*, 1882, p. 83.
† See *Ibid.*, p. 83.
§ *Annual Register for 1887*—Chronicle for October in *Ibid.*
** *Ibid.* for 1892—Chronicle for August.

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the formal account of the disaster, as it was given in the London *Times*. It appears that,

"the *Anglia* was about to anchor in the Jellingham Channel, near the mouth of the Hooghly, and while turning to anchor, appears to have struck upon one of the sandheaps which are a peculiar feature of that channel, and are apt to form suddenly. She capsized immediately, but lay for some time on her beam ends, with her side above water. The majority of the officers and crew, and the only two passengers on board, managed to scramble on to the side, and remained there till picked up by the boats of the British India steamer *Goa*; but the engine room hands, and three sailors in the forecastle, were unable to escape, and perished. A very painful scene was witnessed by the survivors, etc. The three sailors who were in the forecastle when the ship turned over, found it impossible to escape. They put their heads through the ports and begged for help. Every effort was made to save them, but for want of proper tools the efforts to tear away the iron plates were unsuccessful; and as the hull slowly settled down, the boats were obliged to put off, and leave the unfortunate men to be drowned. Dangerous as the navigation of the Hooghly is known to be, it is a long time since so serious an accident has happened; but only a year ago the British India Co.'s steamer *Dunera* narrowly escaped the same fate, almost precisely at the same spot." *

Then as regards the fearful cyclones to which Calcutta and the Gangetic delta are subject, it is well known that the Bay of Bengal has been peculiarly subject to them. Almost every part of its coasts has from time to time been devastated by them, nearly every locality having its own special tale of horror and ruin to recount.

* London *Times* of August 28, 1892, p. 4. [N.B.—We ought to state that these disasters are in no wise due to faulty or careless navigation, but to constant changes made by the stream in the ship channel.]

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The historical records of India are full of such cases, which have been handed down from generation to generation in the native annals.

These cyclonic storms may occur at any period of the year, though they are rarest in February; while they are most common in April and May, and again in August and September: periods which are more or less coincident with the transit of the sun in the zenith.

The destruction created by some of these storms has at times proved truly appalling. Thus, in an article in the *Calcutta Review*, No. 36, it is asserted that before Calcutta was founded, Sangor Island, at the mouth of the Hooghly, contained 200,000 inhabitants, who were all swept away in 1688, in one night. *

The records of the city of Calcutta itself also testify to numerous instances of severe losses to both life and property, inflicted upon that town by cyclones. On October 5, 1864, for example, a great cyclone occurred, followed by a "bore" or tidal wave in the Hooghly, 30 feet high, which did immense damage to the shipping and houses. †

The destruction created by this storm which extended over a large area, seems to have been enormous everywhere in its track; about 100 ships are said to have been lost, and about 60,000 persons perished in it, whole towns being nearly destroyed by it. § This was followed on November 1, 1867, by another storm, which though not so generally destructive as that of 1864, did great damage at Calcutta and in the surrounding country, about 60,000 houses being unroofed, much small shipping lost, and the crops of Lower

* See Murray's *Handbook for the Bengal Presidency*, 1882, p. 83.
† Haydn's *Dictionary of Dates*, 14th edition (Article "Calcutta").
§ *Ibid.*

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Bengal destroyed. * But the appalling calamity marking the track of the great cyclone of October 31, 1876, far exceeded all previous records of damage done, in modern times at all events. This time the vortex of the storm seems to have passed on the opposite or eastern side of the delta, and the heaviest losses occurred in the country adjoining the Megna river, near the confluence of the Brahmaputra with the Ganges.

"At midnight," says Sir Richard Temple, "a furious wind drove the sea water into the estuary, thus banking up the river for many miles." "The wind then circling round after the manner of cyclones, brought its force to bear on the accumulated mass of river water, driving it seawards. Thus there was a tremendous refluence of the flood, completing the submergence of the entire neighbourhood, and placing hundreds of populous villages under many feet of water." "More than 100,000 people were drowned in the darkness of that night, and the morning broke upon districts where the retiring waters disclosed death, ruin, and desolation." †

In some villages almost the whole population was completely exterminated, with the exception of a few individuals who managed to save themselves by clinging to the tops of trees, etc.; and of course cattle and other domestic animals perished almost without exception. These brief and terrible details, which we must endeavour to compress within the narrowest possible limits, sufficiently prove the fearful nature of some of these visitations in Bengal and its adjacent seas, and show that there is probably no other region

* Haydn's *Dictionary of Dates*, 14th edition (Article "Calcutta").
† *India in 1880*, by Sir Richard Temple, late Lieut.-Governor of Bombay, 1881, pp. 380—1.

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on earth more subject to suffer from disasters consequent on the conflicts of the elements.

The last of the great river deltas, which we propose to select as a type deserving of special notice, is that of the Nile—the parent of Egypt.

This great historic river, inseparably connected with the earliest annals of the human race—and already famous when shut out from the purview of antiquarian research in the mists of antiquity—contains so many examples of phenomena unprecedented elsewhere, that no survey of the world's great river systems, however brief, could be esteemed complete without some recognition of the claims of the Nile to hold a leading place as one of the grandest of all streams; while its embouchure, opening as it does into the comparatively still waters of the Mediterranean, has, as might have been expected, formed by its sedimentary deposits one of the most perfect specimens of a river delta at present existing, namely that of a triangle with its base resting on the sea, and its apex at what was probably near the original head of the river estuary; indeed it was in consequence of its almost perfect resemblance in shape to the capital D of the Greek alphabet, that the name "Delta" was first given to it—this term being subsequently applied by geographers to similar formations at the mouths of other rivers.

In former times the Nile discharged itself into the sea by seven mouths; but at the present day there are but two branches, which enter it, one at Rosetta, on the eastern side of Aboukir Bay, and the other at Damietta, to the west of Lake Menzaleh, through whose eastern margin the Suez Canal was excavated, from a point now known as "Port Said," and it is

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estimated that a volume of 61,500 cubic feet of water per second is discharged by these channels into the Mediterranean during the low water stage of the Nile. * The Rosetta and Damietta branches separate at a small place called Menâsheh, about 12 miles by river from Cairo, where gigantic weirs called the "Barrage" have been constructed for irrigation purposes at an immense cost. This point of separation forms the apex of the delta, and here the river in ancient times used to divide into three branches, but partly by natural changes in the river channels, and partly by artificial engineering works, the third or Sebennytic branch, which flowed between the other two, has now been closed as one of the regular mouths of the Nile. The delta of the Nile, like all alluvial formations, is almost wholly a dead flat country, and contains what is probably some of the richest soil in the world; which is generally almost black in colour. When dry, the earth resembles a species of very hard clay, or pottery, and when wet, it is of a soft adhesive nature, not unlike a piece of black cheese. Magnificent crops of cereals, pulses, and other productions, are raised by the Fellâhin on these lands, by whom as many as three crops are sometimes raised on the same ground, in the course of a single year, where water for irrigation is constantly available. The black nature of the soil caused the land of Egypt to be known among the ancients as "Kamit," or the land of "*Kam*"—the "*Ham*" of the Bible—signifying "The Black Land." † Among the Arabs the black earth, which extends a long distance up the Nile valley, is spoken of as "*El Beled*," liter-

* *Encyclop. Brit.*, 9th Edition, Vol. xvii., p. 504 (Art. "The Nile").
† Murray's *Handbook for Egypt*, 1891, Part i, p. 13.

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ally "*The* Country," or the cultivated ground, in contradistinction to the uncultivated waste, or desert country.

The port for the commerce of the Nile is, as we know, at Alexandria, which lies some thirty miles to the westward of the Rosetta mouth; while Damietta is some ninety miles still further to the eastward. At both these places are towns of considerable size, especially at Damietta; but as ports for ocean going ships they have been completely eclipsed by Alexandria, and are only resorted to by small vessels and fishing boats. Goods landed at Alexandria for Cairo, or Upper Egypt, can be conveyed either by rail, or by the Mahmûdîyeh Canal, a fine work begun by Mohammed Ali in 1819, having an average width of about 100 feet. This canal joins the Nile at Atfeh, on the Rosetta branch, and has a length of about 50 miles. Part of its course is identical with the ancient Canopic channel, which once formed one of the seven branches by which the Nile reached the sea. *

The river Nile for the last 1000 miles of its course below the second Cataract is so well known, that it would be needless to occupy space in these pages by any descriptive account. We shall therefore confine ourselves to a short general description of the famous river as a whole. Viewed as a great river system, it is full of interest and instruction. For ages, as everybody is aware, the sources of the Nile remained a mystery, though numerous attempts were made to solve it, all of which proved unsuccessful. It was not till 1858 that the first of the great lakes, the Victoria Nyanza, was discovered by Captain Speke—and subsequently in 1864 the Albert Nyanza by Sir Samuel

* See Murray's *Handbook for Egypt*, 1891, Part i., p. 137.

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Baker. Since then numerous additions have been made to our knowledge of these regions; but it still remains to be proved whether or not the Nile may not flow into these lakes by some more distant and as yet unknown sources, farther to the southwards.

The Victoria Nyanza is situated on the equator (which nearly bisects it) where it is crossed by the parallels 32° to 34° of East Longitude—and its size is about 230 miles by 220, with a water area of 27,000 square miles. * This immense lake also lies within the region of constant rains, and though the area of its catchment basin has as yet never been ascertained, it is certain that it must continually pour forth a vast volume of water, which passes over the Murchison Falls in about Lat. 2° 18′ N., Long. 31° 50′ E. Some twenty-five miles lower down, the river enters the Albert Nyanza, whose functions as one of the sources of the Nile are stated by the *Encyclopædia Britannica* to be those of a great *backwater*, with an area of about 2,000 square miles. † At this point of its course, the river is known by the Arabs as "Bahr-el-Gebel," or the River of the Mountains, and continuing its course northwards, it is joined about Lat. 9° N. by two important tributaries, the "Bahr-el-Ghazel" or "Gazelle River" and the "Sobat" after which it is known, as far as Khartûm, as the "Bahr-El-Abyad" or "White Nile," so called from its clay coloured waters, which have a somewhat milky appearance. The length of its course from the lakes to Khartûm is about 1800 miles, and it is navigable to Gondokoro situated in Lat. 4° 54′ N. about 1420 miles above Khartûm—at

* *Encycl. Brit.*, 9th Edition, Vol. xvii., p. 504 (Art. "Nile").
† *Ibid.*, p. 504.

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this latter point it is joined by the "Bahr-el-Azrek," or "Blue Nile," a turbid stream, thick with the fertilizing mud which it carries from the Abyssinian Highlands, where its head reservoir is said to be Lake Tsana, a sheet of water (whose area is about 3000 square miles) which is situated in Lat. 12° S. which parallel divides the lake into two nearly equal shares, between Long. 37° and 37° 30′ E. Its principal tributaries between this point and Khartûm are the Dinder and Rahad, and it is navigable for steamers etc., as far as Fazoglé.

From Khartûm, * Lat. 15° 34′ N., Long. 32° 31′ E., the point of junction of the White and Blue Niles, the river flows in one undivided stream—the "Bahr-El-Nil" or true Nile—fed only by a single affluent, the Atbara. From the mouth of the Atbara, a distance of more than 1800 miles to the sea, its course is nearly the whole way through a desert region, in a great part of which rain rarely or never falls. There are nominally six different cataracts, marked on the maps at different points of its course below Khartûm; but so little was the true nature of the river really known up to the time of the British expedition of 1884-5 for the relief of General Gordon, that many people supposed until then that these were the *only* obstructions.

Nothing however can be further from the truth. Briefly stated the following is the true state of the case, which so far as we have seen is not specifically stated elsewhere in books. The river is clear from its mouth to Assouan, where the first Cataract bars the

* The name of this city has been spelled in several different ways Khartoom, Khartoum and Khartûm. The last form is the one adopted in British official History of the Soudan Campaign, and approximates more nearly to the Arabic than the other spellings.

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way; but is still passable by a dahabîyeh, or other small craft, when the wind is favourable and the river not too low: the boats being generally dragged up the "*Bâb-es-Shellâl*" or "gate of the cataract," by a strong force of Arabs, with the aid of tow ropes, etc. The course is then clear as far as Wadi Halfa, the present Egyptian frontier station, some five miles below the second or Great Cataract. Here the river is a succession of rapids of the most formidable description, completely impassable to vessels, except when the river is at its highest stage, for a short time in each year. They extend through a space of several miles and are called by the Arabs "Batn-el-Hâgar" or "The Belly of Stone." On the west bank, just below this rocky gorge, is a high cliff called "Abûsir," from whence a magnificent view of the cataract is obtained. It is surrounded on all sides by the drifting sands of the Nubian desert, whose surface presents to the eye a glowing expanse of reddish sand, broken in all directions by ranges of sterile waterless hills. The great river flows below, its channel broken up into numerous streams by a succession of rocky islands, carpeted with dwarf bush, and grasses of the deepest emerald green. It is impossible to conceive anything wilder, more beautiful, or more impressive than the scene as we saw it during our recent visit, just as the sun was sinking behind the distant desert hills, which its declining rays were tinting with a deep shade of rose-pink. Away towards the south, the great river flows through regions of which little is really known, except from the records of the British boat expedition of 1884.

We understand that the Egyptian archives, when searched by British officers for data for use by the

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proposed expedition, furnished but little information of a precise or reliable nature; and though from the maps it appeared that there were but six principal cataracts, officers who accompanied the boats report that between the second and third cataracts, the river is almost constantly impeded by rocks and rapids of more or less serious character, throughout a section of the river upwards of 200 miles in length. From the third to the fourth cataract, some distance above Korti, the point where the British expedition stopped in their ascent of the river, its course is fairly clear of obstruction, but from the fourth to the fifth cataract, near Berber, the whole river is again a succession of rocks, falls and rapids. From Berber to Khartûm, it once more becomes tolerably clear, and is impeded only by the sixth or "Shabloka" cataract, some 55 miles below Khartûm, which however is of a comparatively mild description, as General Gordon's steamers used to pass it in safety, except at the lowest stage of the water. Such described, as briefly as we can, is the course of the Nile as far as the now celebrated city of Khartûm: and it may serve to give some idea of the length of its course to the great lakes, if we say that roughly speaking it is nearly 1000 miles from the sea to the head of navigation, at the second cataract; and that the traveller there finds himself in or about half-way, by river, to Khartûm, and when he arrives at Khartûm, he will then be about half-way to the Victoria Nyanza. These distances however the reader must be careful to remember are merely approximate: for in fact the real length of the great river channel has never been surveyed, and is still but very imperfectly known,

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though the writer in the *Encyclopædia Britannica* gives it as 3370 miles; an estimate which we think, considering its winding nature, must be considerably below the actual length.

In consequence of these difficulties in the way of navigation, though the river may be navigable all the way at the very highest stage of the water, when rocks and rapids are buried deep under stream, the risks are so great that the usual trade routes for goods, going to and from the Soudan, are two in number, first via Korosko, situated in Lat. 22° 50′ N., between the first and second cataract, to Abu Hammed, and Berber (a desert city, situated on the Nile bank, in Lat. 18° N., Long. 34° E.) by camel caravan, a march of about 380 miles through the desert—or secondly, via Suākim on the Red Sea and thence by caravan to Berber, a march of 275 miles also through the desert. From Berber the boat journey is resumed, and goods are carried via Khartûm and the White Nile, as far as Gondokoro, Lat. 4° 54′ N.; beyond Gondokoro they are generally transported on the heads of native porters to their destination.

Since the rebellion in 1884 both these routes are however practically closed to commerce.

In any description of the Nile, it would be impossible to omit some notice of the inundations, which are decidedly among the most remarkable phenomena connected with that river. From the forks of the Nile at Khartûm to the sea, a distance not far short of 2000 miles, the river receives as we have said, but one regular affluent, the Atbara, a large stream 400 yards wide, which joins the Nile in Lat. 17° 37′ N, about 140 miles below Khartûm. Nearly the whole

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of this great region lies within the desert or rainless zone—where there is no regular rainy season, and where even a shower is a rarity. Torrential rain bursts however occasionally occur, but they only last a short time, and months may elapse, perhaps even years, before another drop falls. Even dews are unknown for the greater part of the year; and as a rule in this desert, a man may lay his gun on the ground beside him at night without its ever rusting.

The whole country is one vast, barren, almost herbless desert of orange red sand and rock; mountain, valley, and plain, all being tinted with this same colouring; and presenting a scene of surpassing desolation. As the eye ranges over the mighty expanse, except along the very edge of the river, not a trace of vegetation is in general observable, and in many places Egypt is only a few yards wide—a green streak drawn across the desert. During the spring and early summer months, the simoom, an intensely dry, hot wind, sweeps almost constantly across these solitudes, carrying with it eddying columns of sand and dust. Sir Samuel Baker met with it in 1861, throughout nearly the whole of his desert march of over 700 miles from Korosko via Abu Hammed, Berber, and the Atbara, to Cassala. The holiday tourist to Lower Egypt and Cairo, will also meet with it, blowing from the S.E., from the latter end of March till the middle of May. He will hear it spoken of as the "Khamâsin," so called from blowing at intervals during a period of 50 days. An unusual stillness of the atmosphere generally precedes its approach:—suddenly "the air assumes a dusky yellow hue, from being laden with impalpable dust, through

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which the sun shines obscurely (often appearing of a deep red colour) "and gradually becomes quite concealed." * During the prevalence of the simoom such is its peculiar dryness, that even the skin "becomes quite dry and shrunk, and sometimes a prickly sensation is felt all over the body." †

Such is the region through which the Nile flows for this immense distance, variously stated at from 1800 to 2000 miles, in which vegetation is confined to the immediate vicinity of its waters, or else to alluvial flats irrigated by artificial canals. In some places the "land of Egypt" does not extend more than ten or twenty yards beyond the water's edge—the rest is desert. The tourist from Assouan to Wadi Halfa will see many such places: but below this point,

"Egypt consists properly of a single valley, upon an average eight miles in breadth, extending from Assouan to Cairo, a little below which the country assumes the shape of an equilateral triangle (the Delta) the base of which rests upon the sea." §

"Egypt (says Monsieur Mangin) is in fact *the Nile:* the Nile makes, preserves, and fecundates Egypt; which without this grand and ever famous river would immediately cease to be." **

"The world (says Miss Martineau) has seen many struggles; but no other so pertinacious, so perdurable, and so sublime, as the conflict of these two great powers" (the Nile and the Desert). The river "appears to the inexperienced eye to have no chance, with its stripling force, against the great old Goliah, the desert; whose might has never been relaxed, from the earliest days till now: but the giant has not conquered.

* Murray's *Handbook for Egypt*, 8th Edit., 1891, p. 9. (remarks on Climate etc.)

† *Ibid.*

§ *Egypt & Nubia*, by J. A. St. John, 1845, p. 49.

** *The Desert World*, by Arthur Mangin, p. 118 (translated from the French), 1869.

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Now and then, he has prevailed for a season"—"but he has once more been driven back, and Nilus has risen up again, to do what we see him doing in the sculptures—bind up his water plants about the throne of Egypt." *

The plains channel of the Nile is sunk to a considerable depth below the general level of the country, throughout almost its entire course. For long distances, in Nubia, the great river flows enclosed between high walls of rock on either side, and the desert comes up to the very edge of the banks; lower down however, during its course through Egypt, it winds through alluvial flats, but is still almost always bounded by high banks of earth, rising from 15 to 20 feet or more above the water during low Nile. The whole way from the forks of the Nile at Khartûm the river flows, as we have said, through what is practically a rainless region; until it reaches the delta, when it enters the region of winter rains. It is therefore evident that except by a heavy rise in the river, or else by means of artificial irrigation, very little of the plain can be irrigated. Irrigation is effected first by engineering works, such as canals, by which water is conveyed long distances from higher levels to the surface of the land; some of these are of very ancient date, going back according to Aristotle, Pliny and Strabo, as far as the time of Amenemhat III. (about B.C. 2300), and Sesostris, or Ramses the Great (began to reign about B.C. 1333). Irrigation is still however mainly carried on, probably as it was then, by the "*Sâkiyeh*," or waterwheel, worked by oxen, and the still more primitive "*Shâduf*," or pole and bucket, worked by manual labour of the peasantry.

* *Eastern Life, Past & Present*, by Miss Harriet Martineau, 1847.

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To raise the water to the surface, very often from three to four or even five separate lifts must be made in this way, by different parties of men, each "*Shâduf*" being worked by one, or sometimes by two men, standing on platforms one above the other—a man being able thus to throw up water to a height of about eight feet. The water then runs along a gutter and is distributed over the garden by a series of furrows, which are opened and closed as occasion requires. The process is however a very laborious one—and were it not for the inundations and the fertilizing mud which they bring down to manure the ground, Egypt would quickly relapse to its original condition of a desert.

The peculiarity of the inundation of the Nile is, that it comes about without a drop of rain having fallen perhaps for months previously, and under a cloudless sky of the deepest azure; the river is at its lowest, when without any apparent cause, it suddenly begins to rise. This event which is of such vast importance to the welfare of Egypt, has from the earliest times been waited and watched for with intense anxiety by the whole population. Its progress may be described somewhat as follows:

The river generally begins to rise in April, on the Blue Nile, owing to the rains which are then pouring in the equatorial regions, where they are drained by the great lakes; and in May the rise of the river reaches the forks of the Nile at Khartûm. The monsoonal rains in their progress northwards begin here in June, when the White Nile also commences to rise; and judging from Sir Samuel Baker's account the Arabs seem to expect the coming of the Atbara (the third

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great tributary stream) towards the latter end of that month. Some account of the sudden advent of this flood will be found in our section on Climates and Temperatures—where together with other similar phenomena, the story of the coming of the great Atbara is sketched from the graphic account so admirably given by Sir S. Baker. * The rains generally come as far north as about Lat. 17°, and thereabouts they gradually cease; beyond that point the rainless zone begins. At Cairo the effects of the rise in the south is not generally felt until June, the important intelligence of an approaching inundation being (at the present day) immediately telegraphed from Wadi Halfa, the moment the river begins to rise there. In Lower Egypt the inundation occurs without rains and continues about three months, but does not reach its highest point until the end of September, but there is often a sudden and final rise in October, after which the flood begins steadily to subside; and by the end of January the lands it has covered begin to dry up again, and the river is thenceforth confined to its natural channel, gradually sinking lower and lower, until it rises again the following year.

A rise of about from 24 to 26 feet at Cairo is considered a good average one, and the highest rise of modern date was 27 feet 3 inches. † The river at this time is some 5 miles wide opposite Cairo, and extends right across the valley to the foot of the Pyramid range at Gizeh. For ages all these phenomena have been

* *The Nile Tributaries of Abyssinia*, by Sir Samuel W. Baker, 1861, pp. 51—54. This event occurred on June 24th, when Sir S. Baker was there in 1861.

† See Murray's *Handbook for Egypt*, 1892, p. 19.

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closely watched by generation after generation of the people of Egypt, and since the beginning of the eighth century of the Christian era there has been a regular Nilometer at Cairo, for recording the height of these floods; indeed even long before that date Herodotus and Diodorus Siculus state that several of the Pharaohs erected Nilometers at Memphis and other places for the same purpose. The supreme importance to Egypt of a good inundation can hardly be realized in England; and such is the anxiety of the whole people to hear how it progresses, that it is usual, during the whole period of the rise of the Nile, to proclaim the measured increase of the river daily through the streets of Cairo by public criers, to each of whom a particular district is allotted. *

The causes of the inundations have naturally been in all ages a burning question in Egypt, and have given rise to endless theories. Among the ancient Greeks for instance, many people supposed that the waters were banked up by the north wind, which at that season frequently blows from the Mediterranean; others again believed that the waters of the sea flowed up like a tide at the time of the inundations over the land of Egypt. †

Among the Copts on the other hand it is quite an article of belief, that on a certain night, to wit the 17th of June, a *miraculous drop* falls from heaven, and so causes the great river to rise. This night is known as the "Lêlet-en-Nuktah," or "the Night of the Drop," and was formerly observed as an important anniversary and one of the principal "Festivals of the Seasons,"

* See Murray's *Handbook for Egypt*, p. 229.

† See "Herodotus" Book ii. (*Euterpe*), Sect. 20 to 22, translation by Henry Cary, Oxford 1847. London Edition of 1891, p. 88.

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and it is said that even still many piously disposed persons spend the greater part of that night on the river bank in watching and in prayer. The next great festival connected with the inundation is that of the Cutting of the Canal (Yôm-wefa-el-bahr) which is regarded as a ceremony of great importance, and generally takes place, according to the state of the river, about the 15th or 16th of August, accompanied by great national rejoicings. It consists of cutting through the dam, which closes the entrance to the canal, and is carried out in the presence of a vast concourse of people under the direction of the Governor of Cairo, who arrives on the spot escorted by bodies of troops and other attendants. This pageant is supposed to represent the official recognition of the fulfilment of the annual blessing, which the inundation of the Nile confers upon the land and the people of Egypt.

The inundations of the Nile may now be regarded as being pretty clearly ascertained, to originate first in the great equatorial rains, which in the region of the Central African lakes accompany and follow the vernal equinox; these are, secondly, intensified by the torrential rain-bursts in the zone of single rainy seasons, and by the monsoonal rains, which follow the passage of the sun up to the time of the summer solstice.

The sun as we know, on reaching the tropic of Cancer, about Lat. 23° 28′ N. on June 22, begins to recede towards the south; but the rains still for a time continue to advance, and it is generally supposed that in July they reach as far north as about Lat. 17°—beyond which the rainfall is as we have said, very intermittent and uncertain, and in some years fails altogether. But

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the mighty waterfloods created by the southern rains continue their forward course towards the ocean and pour down along the Nile channel, charged with the fertilizing mud of the tropical plains, to spread it over the land of Egypt, and thus bring incalculable blessings to remote lands and their inhabitants, in regions where rain seldom falls.

At Cairo for instance the average annual rainfall does not exceed about one inch, and in Upper Egypt rain seldom falls at all; what is called a shower often consists of only a few heavy drops, though the sky may be black with what look like rain clouds, and hough thunder peals with ominous vehemence.

In the equatorial regions, as we have pointed out elsewhere, the rains are almost continuous throughout the year. Rivers therefore which flow from thence, flow for ever, from sources that are exhaustless; and so, in the case of the Nile, the great river has overcome the thirsty sands, and has continued throughout uncounted ages to flow without ceasing through a region comprising the greatest and driest deserts in the world.

Sir Samuel Baker has described in graphic terms the wonderful phenomena which accompany the bursting of the monsoon upon the Abyssinian highlands:

"No one (he says) could explore these tremendous torrents, the Stetite, Royan, Angrab, Salaam, and Atbara, without at once comprehending their effect upon the waters of the Nile. The magnificent chain of mountains from which they flow, is not a simple line of abrupt sides, but the precipitous slopes are the walls of a vast plateau, which receives a prodigious rainfall in June, July and August, until the middle of Sep-

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tember, the entire drainage of which is carried away by the above-named channels to inundate Lower Egypt." * -

We have already alluded to the tendency to sudden and violent floods, to which the mountain courses of streams are always subject, and the incredible rapidity with which they sometimes rise; this is well illustrated by the sudden arrival (like a thief in the night) of the mighty stream of the great river Atbara, of which all the above-named rivers, mentioned by Sir S. Baker, are affluents. Though we have cited it elsewhere, as a notable instance of a sudden flood, † it may be convenient to briefly repeat its salient features here. On the 23rd of June 1861 the drought had been unbroken for months; the heat was intense; the sky unspotted by a cloud: while the fiery breath of the simoom had desiccated the land so completely that vegetation had apparently almost perished, and the bed of the Atbara consisted merely of a glaring expanse of dry sand, without one drop of water, except in a few isolated pools.

On that night Sir Samuel Baker and his party were resting by the margin of the river, when a noise was heard like distant thunder—a sound which had not been heard for months—which came nearer and nearer. Suddenly shouts were heard from the Arab camp, of "El Bahr! El Bahr!" (the River—the River); there was but barely time to escape, when the waters arrived, and (says Sir Samuel Baker)—

"On the morning of the 24th of June I stood on the banks of the noble Atbara river."—"In one night there was a mysteri-

* *The Nile Tributaries of Abyssinia*, by Sir Samuel W. Baker, 1867, p. 468.

† See our section on Climates and Temperatures, Vol. i, p. 98.

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ous change"—"dust and desolation yesterday, to-day, a magnificent stream, some 500 yards in width, and from 15 to 20 feet in depth, flowed through the dreary desert." *

By the third of July the rains themselves had arrived, and came down in torrents, in the way usual after the bursting of the monsoon. These rains, at first intermittent, towards the middle of the month became more constant. All the dry stream beds were now converted into rapid torrents which rushed towards the main stream with impetuous velocity, to swell its already formidable tide; "banks of earth (says Sir S. Baker) became loosened and fell in, and the rush of mud and water upon all sides, swept forward with a violence which threatened the destruction of the country, could such a tempest endure for a few days." †

We shall add a short sketch of one of these storms, extracted from the deeply interesting account given by Sir S. Baker, as it may serve to give those of our readers who may never have visited tropical regions some idea of the violence of meteorological phenomena which annually recur in these localities.

"We shortly halted for the night (he says), as I had noticed unmistakeable signs of an approaching storm."—"There was no time to prepare food; the thunder already roared above us, and in a few minutes the sky, lately so clear, was as black as ink."—"A rain descended, with an accompaniment of thunder and lightning, of a volume unknown to the inhabitants of cooler climates; for several hours there was an almost uninterrupted roar of the most deafening peals, with lightning so vivid, that our tent was completely lighted

* *The Nile Tributaries of Abyssinia*, by Sir S. Baker, 1867, pp. 51 to 53.

† *Ibid.*, p. 92.

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up. Being as wet as I could be, I resolved to enjoy the scene outside; it was curious in the extreme. Flash after flash of sharp-forked lightning played upon the surface of a boundless lake; there was not a foot of land visible, but the numerous dark bushes projecting from the surface destroyed the illusion of depth that the scene would otherwise have suggested. The rain ceased, but the entire country was flooded several inches deep, and when the more distant lightning flashed as the storm rolled away, I saw the camels lying like statues built into the lake." *

The rush of all this water, everywhere pouring over a vast extent of country, and all hurrying towards the Nile, gives us some insight into the wonderful water supplying capacity of this mighty river system, and the reader will probably cease to wonder that notwithstanding any amount of evaporation which may occur in Nubia and Upper Egypt, enough water is still carried down to be the parent of the great inundations which annually cover the Nile valley and the delta of Lower Egypt with its turbid but fertilizing flood.

Leaving now the historic region of the Nile, we pass to the consideration of another great river system of a different type, but which of its kind is certainly one of the most remarkable of all streams.

We refer to the River Indus, † whose frowning rocky gorges and impetuous flood at present constitute a leading factor, as a line of defence, upon the north western frontier of our Indian Empire.

* *The Nile Tributaries of Abyssinia*, by Sir Samuel W. Baker, 1867, p. 105—6.

† "Indus"—in Sanskrit *Sindhu*. (Whence doubtless the territory of Sindh takes its name.)

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The Nile, as we have seen, is an example of a great river ordinarily fed by the downpour of the tropical rains. The Indus on the other hand, is primarily dependent for its water-supply upon the melting of the eternal snows, which have accumulated upon the elevated plateaux and peaks of the Himalayas.

In our section on "Great Mountain Ranges" we have described as clearly as we could the laws which (so far as present knowledge extends) appear to govern the winter snowfall there. Like almost all great rivers proceeding from such sources, the Indus takes its rise at an immense elevation—in "The Abode of Snow," as the translation of the native name of Himalaya implies.* The locality lies in about Lat. 32° N. and Long. 81° E. on the northern slopes of the sacred Kailas mountain, not far from the sources of the Sutlej, another great river, which subsequently unites its waters with those of the Indus.

The drainage area of the Indus is estimated at 372,000 square miles, and its total length at a little over 1800 miles.† It will thus be seen that it is by no means the longest river in the world; it cannot compare for instance in this respect with the Mississippi, whose length is quite 2500 miles; or with the still greater length of the Mississippi-Missouri system whose length amounts to some 4000 miles. Nevertheless as a mighty torrent, thundering with indescribable violence through precipitous ravines, and eating its way by the attrition of its swiftly flowing waters through wild rock-cut gorges of enormous depth, the phenomena which

* From the Sanskrit "*Hima*"—snow, and *Alâyâ*—abode.
† *Encycl. Brit.*, 9th Edition, Vol. x., p. 68. (Article "Indus.")

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mark the track of the Indus river are probably elsewhere unexampled.

The wonderful gorge, near Iskardoh, in Little Thibet, where the river bursts through the western ranges of the Himalayas, which we have already described in our chapter on mountains, is certainly the most marvellous instance of the almost omnipotent power of running water which is to be found in any part of the world. But this is only one of a succession of mighty cañons, which this river has excavated throughout its mountain track. For nearly the whole of its upper course it winds at intervals through similar, though less gigantic cuttings, which constitute some of the grandest pieces of mountain scenery in the world. The course of the torrent is here subject to tremendous floods, which at times seem about to sweep everything before them—while at other moments, even in summer, the stream is said to dwindle down to a fordable depth during the night; but during the day it again swells into an impassable torrent, from the melting of the snows on the mountain tops. This character the river retains until it enters the Panjab, near Derbend, in Lat. 34° 25′ N., Long. 72° 57′ E., where it is a swift stream about 100 yards wide, and of no great depth, flowing through an irregular channel studded with sandbanks and islands. During the cold weather it is at times fordable here in many places, but its uncertain and dangerous character, its liability to sudden floods and freshets, still continues. It was thus that the celebrated Ranjit Singh for instance, while crossing this river in one of his forays against the mountain state of Kashmir, about 1823, is stated as we have already mentioned elsewhere, to have lost a force variously

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estimated at from 1200 to 7000 horsemen, swept away by the sudden coming down of a flood.*

These tremendous inundations, which are liable to occur at any moment, and which never can be foreseen or guarded against, together with the inaccessible nature of a great portion of its banks, (which for hundreds of miles consist of lofty and precipitous cliffs), render this river in the highest degree valuable as a line of defence, from a military point of view. Owing to its turbulent character, boats cannot in general be used upon its upper waters; and the usual native way of transportation to and fro, from time immemorial, has been by means of a "*Massak*" or inflated skin, when the river had to be crossed during the period of high water. For a great part of its course also, for the same reason, this river cannot be bridged, except at a few points, and then only by enormously solid and expensive works of engineering skill.

One of these places is the celebrated Attock Bridge, just below where the Indus, at a point about 870 miles from its source, receives the Kabul River, which brings down with it the waters of Afghanistan, in another swift stream of about the same volume and character as the Indus, at their point of junction. Attock in the Rawal-Pindi district, in Lat. 33° 53′ 15″ N., Long. 72° 16′ 44′ E., † is the first point of great importance upon the Upper Indus, in British territory; it was here where in former days the main trunk road to Peshawar crossed the river upon a bridge of boats; which was however always most insecure, and

* *The Imperial Gazetteer of India*, by Sir W. W. Hunter, Vol. vii., p. 11. (Article "Indus River").

† *Ibid.*, Vol. i., p. 381 (Article "Attock").

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difficult to maintain. The normal velocity of the current at Attock is from 5 to 7 miles an hour in the cold season; but during floods the Indus here presents a wild scene of confusion of waters, which at such times rush with fearful violence through the rocky gorge with a sound like that of a troubled sea, and at a speed of some 13 or 14 miles an hour.

A tremendous whirlpool is thus created, which often used to sweep everything before it, frequently compelling the removal of the floating bridge to avert its destruction. Communications then had to be kept up in case of necessity, at great risk, by means of a ferry boat, or a raft constructed of inflated skins, in the manner already described.

This has however all been changed by the opening (in May 1883), of an iron girder bridge, by the North Western Railway of India, which now carries both the railway and the road, across the Indus, high above the reach of floods: its construction was one of the most costly and difficult works on the line. Very striking and impressive is the panorama, as the train passes over this historic gorge, which is justly accounted one of the most picturesque spots in India.

The waves of the great river, here confined within a very narrow channel, foam and boil at an immense depth beneath: to the right is seen the ancient fortress, of Attock constructed by the Emperor Akbar about 1583. It is situated on a commanding height, and presents a most imposing appearance; while the distant country opens up a prospect of wild and rocky sterility, the very type of stern and rugged grandeur. The height of the river is here 2078 feet above sea-level, it having descended from the immense elevation of about 17,000

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feet at its source, with an average fall of something over 16 feet per mile, during a course of some 870 miles consisting of an almost constantly rugged channel, full of rocks and rapids. Thus the very name of "Attock" is said to be derived from a Sanskrit word, signifying "a prohibition"—or "a hindrance," and an ancient law of the Hindu religion forbade the faithful to cross the Indus,* though in modern times the rule has become more honoured in the breach than the observance, and has for many years past been in abeyance.

The tremendous nature of the floods on the Indus may be well illustrated by an instance of one which occurred at Attock on the 10th of August 1838. When the water in the evening stood *90 feet. higher than in the morning.*" †

This gives a good idea of the difficulty of maintaining communications across such a river, which for a further distance of 105 miles, as far as Kalabagh, still preserves the same dangerous character, and continues enclosed for a great part of the way between high perpendicular cliffs. It is at Kalabagh, in Lat. 32° 57′ N., Long. 71° 36′ E.,§ situated in a gorge of the great salt range, where the river at length rushes forth into the plain, and debouches into a level country; and from this point to the sea, a distance about 872 miles, it is navigable for flat-bottomed steamers. **

* See *A Year in the Panjab*, by Major Herbert B. Edwardes, 1851, Vol. i, p. 92.

† *The Imperial Gazetteer of India*, by Sir W. W. Hunter, Vol. vii., p. 15. (Article "The Indus River").

§ *Cyclopædia of India*, by Surgeon-General Edward Balfour, Vol. ii., p. 341.

** *The Land of the Five Rivers & Sindh*, by David Ross, C.I.E., 1883, p. 37.

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We have been careful to mention these numerous technical details, because of the importance of the Indus as a line of defence to North Western India—an invader entering the British Empire in this direction being always liable (should he succeed in crossing the river) to be cut off from his line of communication, without warning and for an indefinite period of time, by a sudden flood. Nevertheless the neighbourhood of Attock, and down towards Kalabagh, "has seen the passage of every conqueror who has invaded India from the north west, from the time of Alexander the Great downwards." *

This is quite true: and that being so, perhaps we shall be pardoned if we venture upon a short digression, upon a point of great military and historical interest (which has been much debated of late years, and has given rise to many differences of opinion) in order to put the matter in what we conceive to be its proper light before the reader. We desire however to premise our remarks on this subject by stating that it is an axiom of military science that rivers as a rule make a *bad* frontier, strategically speaking, being incapable of stopping the advance of a well-led and energetic enemy. There is however no rule without an exception; and we have here to deal with a river of very exceptional character.

The principal invasions of India by foreign conquerors from the north west were three in number. First by Alexander the Great, who entered India early in B.C. 327. He crossed the Indus above Attock, and advanced

* Murray's *Handbook for India & Ceylon*, 1892, Route 13, p. 210.

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without a struggle to the Jhelum. * Secondly, by Timur (or Tamerlane, as he is sometimes called) who invaded India A.D. 1398, and who also encountered but little resistance. † There is some uncertainty as to the exact point where he crossed the Indus; a writer in the *Encyclopædia Britannica* states that it was at, or *near*, Attock, § but the late Surgeon-General Balfour (a learned writer on Indian matters) thinks that it was a place named "Nil-ah" near Kalabagh, where some remains of the ancient town are still visible. ** Thirdly, the last invasion was that led by Nadir Shah, a Persian, in 1739. He also crossed the Indus somewhere near Attock, but met with no resistance till he got near Delhi. †† Now Delhi to Lahore by rail is a distance of 348 miles, and from thence to Attock by the North Western Railway is a further distance of 252 miles, making a total of just 600 miles. §§ The appalling scenes which occurred in the sacking of Delhi by this conqueror are still a matter of tradition among the Indian people. On the 10th of March in that year, a garrison placed in the city by Nadir Shah was almost entirely put to the sword by the people; and the next day the conqueror, whose main army was encamped not far off, gave orders for a general massacre, and from sunrise till midday the city presented a scene of carnage which has seldom been equalled; fire which had been set to the houses,

* *Encycl. Brit.*, 9th Edit., Vol. xii., p. 786 (Art. "India").

† *Ibid.*, p. 793.

§ *Ibid.*, Vol. iii., p. 62. (Article "Attock").

** See *Cyclopædia of India*, by Surgeon-General Edwd. Balfour, Vol. ii., p. 341.

†† See *History of the British Empire in India*, by Edward Thornton, Vol. i., pp. 68—9.

§§ See Newman's *Indian Bradshaw* (Published at Calcutta monthly).

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spread to almost every quarter of the city. On this fatal day a vast multitude of persons perished, and the conqueror, when leaving Delhi, carried off immense treasures estimated at from 30 to 70 millions of pounds sterling; and among other things the famous Peacock Throne, encrusted with precious stones and gems of enormous value. He also seized and carried off the great Koh-i-Nur diamond, which is at present numbered among the crown jewels of England. *

The reader will see from the foregoing details that these invasions of India, via the Indus, were all really *unopposed*, and that being so, it is impossible to quote them as having any real bearing upon the supposed strength, or weakness, of the River Indus Frontier—the question being whether these invaders could have *forced* the passage of the Indus in the teeth of an organized opposition. This may therefore still be regarded as at least an open question.

In an interview with a representative of a London daily paper General Lord Chelmsford was strongly of opinion that the line of the Indus, held by a British Indian Army, with suitable advanced posts, was exceedingly strong, indeed well-nigh impregnable. † The matter had been recently brought to the front by a magazine article headed "India Between Two Fires," §

* See Murray's *Handbook for India & Ceylon*, 1892, p. 131. This celebrated diamond called the Koh-i-Nur or "Mountain of Light," was found in the mines of Golconda in 1550. It was surrendered to England after the conquest of Scinde, in 1849; it then weighed 279 carats, and was valued at £2,000,000; it has since been recut, by Dutch artists, for the Queen, and now weighs 100½ carats, and possesses a greatly increased brilliancy. See Haydn's *Dictionary of Dates* (article "Diamonds.")

† See *The Pall Mall Gazette* of Aug. 24, 1893—(Article on *The Defence of India against Russian Invasion.*)

§ See *The XIXth Century Review* for Aug. 1893, p. 183. (Article, *India Between Two Fires*, by the Hon. George Curzon, M.P.)

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which took a very unfavourable view of our Indian frontier question, "should the Russians be permitted to advance to the Hindu Kush, either north of Cabul, or south of Waklan"—and it asserted that "to talk about the Indus valley *now* (as a line of defence) is to be 13 years behind the time." In the course of a discussion by letters in the *Times* and other newspapers, however, Lord Chelmsford (who no doubt had had under his consideration all that had been said on the other side, in the newspaper controversy then going on) makes the following rejoinder:

"No period of time can alter the natural strength of the Indus Valley frontier. With the advanced posts of Quetta and Peshawar, giving us the command of both flanks of the Indus, and with a belt of most difficult country 200 miles broad, between the natural border of Afghanistan and the unfordable Indus River, which can only be bridged with the greatest difficulty during 6 months of the year; India possesses a defensible frontier of extraordinary strength"—and (His Lordship concludes with these words,) "I am strongly of opinion that the natural difficulties of our North West frontier, which can be so enormously increased by artificial means, are quite sufficient to secure India from any successful attempt at invasion." *

This is a highly important matter; we shall therefore quote the opinion of another most distinguished general officer on the same subject. In a letter to the *Times*, General Sir John Adye has also expressed what is practically a similar view of this case, and says,

"our North West frontier from its natural difficulties is very safe and almost impregnable." "His (Mr. C's) views on the supposed danger of India are exaggerated and unsound.

* Extracts from letter in the London *Times* of Aug. 21, 1893, p. 4, signed "Chelmsford, General."

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We are the great rising power in the East; and the main lines of our policy should be to govern India well, and maintain friendship with the Chinese." *

The "second fire," to which allusion was made, was to France in Siam. Our naval friends would probably have a word to say on that. As long as Britain holds command of the seas, France can do *nothing* against us in India. She would have more to fear from us than we from her. But the greatest interest of both countries is *peace*. Also, as long as England is supreme at sea the British line of communication will be far shorter, safer and easier, than that of any invader coming from Central Asia. "It is not in the Indus itself (says Colonel Hanna) that I see India's true scientific frontier, but in the combination of that great river with a waterless desert, and a deep and rugged mountain chain." †

The inspection of a good large scale map will however put this more clearly before those who desire to know the exact value of the difficulties in the way of an invader. It will be observed that all rivers of any considerable size join the Indus upon its eastern side, whereas the small streams marked upon its western bank where they are not mountain torrents, are mostly dry nullahs or ravines, which are seldom threaded by streams except during the rainy season. Then again as regards the mountain regions, there are no roads through them, except that via the Khyber Pass, that are passable for any kind of wheeled vehicle, and Colonel Hanna, in the same letter quoted from above,

* Letter controverting Mr. Curzon's views, by General Sir John Adye to the *Times* of Aug. 17, 1893, p. 7.

† Letter in *The Broad Arrow*, (military paper) of Nov. 20, 1895, signed H. B. Hanna—in reply to criticisms on his book *India's Scientific Frontier*.

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proceeds to show the enormous difficulties which an army would meet with in attempting to pass them, by quoting the opinion of the late General Sir Edward Hamley, as follows:

"Accustomed as we are to see the mountain chains of Europe successfully crossed by great armies (said that eminent strategist in 1878) we must remember how different in depth are the ranges of the hills of Afghanistan. In a couple of marches the Russians were through the Bohemian mountains. But here, the shortest pass through the barrier between Cabul and the Indian Valley is 190 miles; the Gumal nearly 300 miles, and not days but weeks are occupied in the isolated march." *

This is as far as we propose to carry this subject. We shall now shortly sketch the plains track of the Indus from Kalabagh to the sea. This section of the river, of about 872 miles, is navigable for light-draught steamers. It is however possible to descend the river from Attock by a native boat, a thing which is still sometimes done, as the trip takes the traveller through much fine scenery; though the journey is rather a rough one. It occupies about five days to descend from Attock to Dera-Ismail-Khan, † a distance of about 195 miles. At Kalabagh, where as we have said the Indus debouches from the great salt range into the plains country, the river has descended to a point just under 900 feet over sea-level. The current is still very swift, but the stream which has hitherto been pent up for a great part of its course, between precipices and high banks, now assumes a much wider

* Letter in *The Broad Arrow*, (military paper) of Nov. 23, 1895, signed H. B. Hanna—in reply to criticisms on his book *India's Scientific Frontier*.

† It is near this point where the Gumal Pass mentioned by General Sir E. Hamley debouches to the westward of the river.

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character, with shifting channels winding among sandbanks and islands, through a flat country. The Scinde Sagar loop of the North Western railway follows the course of the river all the way down to Dera-Ghazi-Khan at a distance varying from about five to ten miles from its bank, where it can keep clear of danger from floods; the stream is in this part of its course obstructed by many sandbanks, and the river bed is often many miles wide.

Thus at Dera-Ghazi-Khan, the Indus at low water is only about a quarter of a mile wide, in the hot season, but after great rains its floods extend over an enormous area, and the river "at this point becomes 18 miles wide and takes 12 hours, and not infrequently 18 to 24 hours, to cross." * So says Dr. Clark a resident physician at Amritsar (Punjab) according to whom, during the last great flood in 1889, the river in one portion of its course "inundated close upon 700 square miles of country." † As these floods subside vast lagoons of stagnant water are left in low lying situations, and as these begin to dry up, some four or five months afterwards, malarial disease becomes very rife. Malarial fever of malignant type, in fact, sometimes assumes the form, according to Dr. Clark, of a regular pestilence on such occasions, hardly anybody escaping an attack.

Proceeding down the course of the river about 78 miles below Dera-Ghazi-Khan we reach one of the most important points on the Indus, namely its junction with "the five rivers" at a point about 490

* *Remarks on Malaria and Acclimatization*, by Dr. H. M. Clark, of Amritsar, in paper read April 1892 in *Royal Scottish Geographical Magazine* for June 1893, Vol. ix., part 6, p. 284.

† *Ibid.*, p. 284.

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miles from the sea and a few miles above the town of Mithankol; these rivers all come from the Punjab to the eastward.

The Punjab or "Panj-ab" is literally in Hindustani, "the land of the Five Rivers,"* because the country between the Indus to the Jumna is drained by five great rivers, the Jhelum, the Chenab, the Ravi, the Beas, and the Sutlej. The three first named unite, forming the Chenab system; and the Beas is an affluent of the Sutlej; the Chenab and Sutlej subsequently meet at a point about forty-six miles from their junction with the Indus, the united streams from thence to where they fall into the Indus being known as the "Panjnad" (lit.—the five rivers). The mighty river Indus after absorbing their waters still rolls on for the remainder of its course to the ocean through a dry and almost desert country, where the rainfall is scarce and uncertain. The plains of Scinde during the hot season appear to the eye to be one vast dead level sandy flat, studded with tracts of arborescent grasses and jungle, over which the inundations of the Indus frequently extend for miles, on either side of its natural channel. The description of Scinde and its great river the Indus, given in the letters and journals of the celebrated Indian General Sir Charles Napier, is full of interest and instruction, and numerous extracts from their most striking passages are given in the Life of Sir C. Napier, written by his brother Sir William, † another distinguished officer, best known to the world as the Historian of the Peninsular War.

* *Encycl. Britannica*, 9th Edition, Vol. xii., p. 847. (Article "The Punjab").

† *Life of General Sir Charles James Napier*, by Lieutenant General Sir William Napier, 1857, 4 vols. 8vo.

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Sir Charles Napier, as all the world knows, was the conqueror of Scinde (1842 to 1846) and perforce, no man studied the vagaries of the great river with keener attention than he did, for it formed his principal line of communications, and the swelling of its waters, or the imminent fear that they would suddenly rise, often set his best-laid plans at naught.

The Indus is an autocrat whose colossal power, even in its calmer lower reaches, is such that the most enterprising leader dare not attempt to oppose it.

The sun and the desert on one side, and the river on the other are apt to set at defiance the puny efforts of man.

"Here (says Sir C. Napier, writing on March 30th 1843) I am between Scylla and Charybdis; to the east impeded by want of water, on the west in dread of inundation. I cannot besiege (Omercote) as the river would be upon me, forming a mighty sea between me and Hyderabad (as people say), probably all exaggerated, but enough to destroy my guns and baggage." *—"April 1. Just heard by express that the waters are rising with fearful rapidity. I must recall the troops, and leave Omercote for next season; this is bad; it will be a rallying point for all our enemies in Scinde, and another army will rise; but I cannot stand against the Indus." †

Its unbridgeable character (except by very great and costly structures like a vast girder bridge of iron) is well illustrated by what has been already stated about its floods and the following extracts—

"The obstacles to any but a floating bridge (says Sir Chas. Napier) are insuperable; we must trust to boats, and build a fort as a 'tête de pont' at Kotree, opposite Hyderabad;

* *Life of General Sir Chas. J. Napier*, by Lt.-Genl. Sir W. Napier, Vol. ii., p. 353.

† *Ibid.*, Vol. ii., p. 354.

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it has fallen in once, undermined by the river, though 200 yards from the bank; in one day 100 yards went down, on a strip along the bank of perhaps a mile."—"The old Indus is a devil when he takes a freak into his head."—"A line of battleships may be floating in midstream at breakfast, and you may dine on the same spot, the same day, on dry land! All these things are great difficulties." *

At Hyderabad, where Sir C. Napier was when he wrote thus, the river is very wide and swift, the flood sweeping down at a rate "of 4 to 5 knots an hour" according to the estimate of his steamboat captains, and the breadth of the current was "from 600 yards to 6 miles. The stream however eternally changes in depth, in breadth, and even in course." The banks average from 4 or 5 to 20 feet in height on one side of the river, along this part of its course, and wherever the stream sets against them they are continually falling away: the opposite side is generally a dead flat. "The banks fall in fast" (says Sir Charles) "hundreds of tons have done so as we passed." †

These extracts give in brief about as clear an idea of this wonderful river as could well be conveyed in a few sentences. From Hyderabad to the sea, a distance of about 110 miles, its character continues much the same, and it flows all the way through a monotonous expanse of perfectly flat country. Sir Charles Napier, however, considers this country "very difficult for war; a dead flat yet without a view: banks of 'nullahs' and jungles entirely intercept sight." § The Beloochees, he explains, used to hide in these

* *Life of General Sir Chas. Napier*, by Lt.-Genl. Sir W. Napier, Vol. iii., p. 146.

† *Ibid.*, Vol. ii., pp. 199 & 200.

§ *Ibid.*, 1857, Vol. ii., p. 362.

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places, and let fly with their matchlocks whenever anyone appeared.

The fact is, it was impossible to march very far beside the river without being stopped by one of these 'nullahs' or ravines, which intersect the country for miles in every direction and were generally masked by bushes and not seen till the men were close upon them. These of course formed admirable hiding places for enemies, and also serious obstructions to guns and baggage, rendering marches very slow and fatiguing. At the battles of Miani and Dabo (fought by Sir Charles Napier against the Beloochees in 1843) such nullahs were upon both occasions strongly occupied by the enemy, and formed the key of their positions. At the battle of Dabo especially, the General says,

"his (the enemy's) position was nearly a straight line; the nullah was formed by two deep parallel ditches, one 20 ft. wide and 8 ft. deep, and the other 42 ft. wide and 17 ft. deep, which had been for a long distance freshly scarped and a banquette made behind the bank, expressly for the occasion." *

"The ever glorious 22nd Regiment" as Sir Charles Napier called them (now the Cheshire Regiment), bore the brunt of the fighting on both these actions, and met with heavy losses in storming these places.

The Indus near its embouchure, like most great rivers, has formed an extensive delta, through which it debouches by a number of channels, none of which unfortunately are navigable for sea-going ships; the port of Scinde has therefore always been at Karachi, situated in Lat. 24^{0} 50′ 30″ N., Long. 66^{0} 58′ 12″ E., † near the western end of the delta.

* Despatches of Sir Chas. Napier after the battle of Dabo, March 24th, 1843.

† Norie's *Navigation*, 21st Edition. Table lvi., p. 312.

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Previous to the British occupation of Scinde, Karachi was a mere fort; since then it has flourished greatly and is now the chief town in Scinde, with a sea-borne trade whose annual value exceeds £4,000,000 sterling.

Hitherto we have said very little about the great rivers of America, whose enormous importance in the trade of the world is every year increasing. "In no single circumstance," says the *Encyclopædia Britannica*, "is the superiority of America over the Old World so conspicuous as in the numbers and magnitude of its navigable rivers," which "not only surpass those of the Old World in length and volume, but are so placed as to penetrate everywhere to the heart of the continent."

Of the great Amazon system we have already given a short account. It is supposed that that mighty stream alone discharges a greater quantity of water than the eight principal rivers of Asia. The La Plata, another great river of South America, is asserted by the same authority to claim a probable superiority over the collective waters of Africa. Personally we are inclined to doubt this fact, nevertheless the La Plata, as we have ourselves good reason to remember, is a very great river, draining an area of some 1,200,000 square miles, and furnishing with its various affluents a length of about 20,000 miles of navigable waters. * The Orinoco, though much inferior in size to these gigantic river systems, is also a very large river, draining an area of at least 400,000 square miles, and said to include navigable waters 8,000 miles in length. The head waters of all these river systems arise in unknown or at any

* *Encycl. Brit.*, 9th Edition, Vol. i., p. 674—675 (Art. "America").

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rate very little known wilds, in the heart of the South American continent.

Turning now to North America the Mississippi (literally in the original Indian language of the country "The Father of Waters") may justly be considered to constitute "a mighty source of wealth and strength to the United States." * According to *The Scientific American*, the Mississippi has no less than

"600 affluents, and a drainage area of 1,257,545 square miles. The traveller can sail from Pittsburg (on the Ohio) 4,300 miles, to Fort Benton, Montana, (on the Missouri), and from Minneapolis 2,200, to Port Eads on the Gulf of Mexico. Should he extend his voyage to the head of navigation upon its 45 navigable tributaries, his journey would extend 16,000 miles, through 23 States and Territories of the (United States) Union." †

This however does not include a vast extent of canoe and boat navigation, upon the head waters of these rivers and other smaller streams, which are computed by the *Encyclopædia Britannica* to jointly amount to a mileage of no less than 35,000 miles. § There has been an unfortunate error made by the early geographers of America, as we conceive, in mistaking the course of the present Mississippi beyond its confluence with the Missouri, as that of the main river. We humbly venture to think that the real "Father of Waters" is the Mississippi-Missouri, which gives a clear navigable channel from the Gulf of Mexico of about 1226 miles to the mouth of the Missouri, and

* *The Influence of Sea Power on History*, by Capt. A. T. Mahan, U.S.N., 1890, p. 36.

† *Scientific American* of August 5, 1893.

§ *Encycl. Brit.*, 9th Edition, Vol. i., p. 675 (Art. "America").

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2679 miles further to the head of navigation at the falls of the Missouri River, a short distance above Fort Benton, or a total distance of 3905 miles. It would have been better in such case to have called the present Upper Mississippi, after passing the Missouri, by some other name. In the first place, the whole character of the Mississippi below that point is governed by the Missouri, which at the junction of the two rivers, is much the larger stream of the two, the Missouri being a huge tawny flood of very muddy water, while the Upper Mississippi is a *clear water* river (which, by the bye, is a comparatively rare thing in America, nearly all the rivers of any considerable size being brown, turbid streams), but below the juncture with the Missouri all the way to the sea it assumes the Missouri colour, a deep yellow brown caused by the friable banks, which all along the Mississippi-Missouri system keep falling into the water, something in the same way as we have already described, as characteristic of the Lower Indus.

Wherever there are high perpendicular clay banks upon rivers, it may be assumed that the stream, especially in the concave portion of curves, is there eating away its banks, their perpendicular character being the result of such falls. The water mines them underneath, and soon the top cracks off and falls into the stream; the loose material is then gradually washed away by the river, in the form of sediment, which causes the waters to be mud-coloured. With a sluggish stream the banks generally fall slowly, but when there is a powerful and rapid current setting strongly against a clay bank (especially if it be formed of alluvial sands and mould) it is sure to fall more or

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less rapidly. Thus on the Indus, the Missouri and the Lower Mississippi these falls are of continual occurrence. They are also often seen on the Nile, the Amazon, and other great rivers.

Now, on the Upper Mississippi, this phenomenon is generally wanting, and we do not remember ever to have seen the banks falling in this way there. In the next place the whole of the Lower Mississippi and a great portion of the Missouri is a river flowing through its "Plains Track," that is to say, the level plains of the surrounding country come up to the very edge of the river, here (in the Lower Mississippi portion) mostly covered in former days by the primeval forest, whereas to the northward of its junction with the Missouri, the Upper Mississippi enters its "Valley Track" and runs through a deep wide valley, several miles in breadth, from crest to crest of its bluffs, with the *clear water* stream of the river, here not generally very deep except during floods, flowing through its midst. The scenery in this part of the Mississippi often presents a series of views, alike most striking and beautiful, whereas on its lower portion the scenery is very uninteresting and monotonous. It is a grand river, but as soon as the impression of its vastness, which at first sight always impresses the stranger, has worn off, there is very little worth seeing upon it, all the way from St. Louis to the Gulf of Mexico. The inundations from the Mississippi in former days were very destructive and covered vast areas of some of the richest lands in North America. These visitations have however now been controlled in a great measure by the construction of enormous banks (called levees) enclosing the stream and confining it to its proper channel. It

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therefore often happens in flood time that steamers on the river sail many feet above the natural level of the surrounding country. Indeed in accordance with a common characteristic of sediment bearing rivers, the banks are generally *highest at the edge of the stream itself*, which thus apparently follows a low ridge running through the bottom lands.* The "levees" therefore, are merely artificial additions made to this natural ridge. But occasional bursts in these constructions sometimes still lay many square miles under water and destroy much crop and property. Thus in 1874 a great flood occurred, which caused terrible suffering and losses to inhabitants of the Mississippi Valley. In consequence of the flat nature of the country, these floods spread with great rapidity, and in the States of Mississippi and Louisiana soon cover large areas.

Owing to the friable nature of its banks and the constant falls of earth from them, the Lower Mississippi is a particularly muddy stream; for long periods the sediment held in suspension is to the water nearly as 1 in 1500 by weight, or as 1 in 2900 by bulk.† Yet it makes excellent drinking water. A glass of water taken from this river is usually so thick that it is almost opaque, but when allowed to stand, the earthy particles quickly fall to the bottom, leaving the water perfectly clear, bright, and tasteless. In former days at New Orleans no other water was used for drinking purposes, and perhaps it may be so still, the mighty flood of the great river being so vast and the stream so powerful, that impurities are quickly

* See *Encycl. Brit.*, 9th Edition, Vol. xvi., pp. 518—519 (Art. "Mississippi River").

† *Ibid.*, p. 520.

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swept away, and become disinfected by infiltration with the earthy particles so thickly suspended in the water. The same remarks hold good with regard to the Amazon, the Indus, and many other great rivers.

The quantities of sediment carried down to the sea by the Mississippi are something enormous. Observations show that the sedimentary deposits annually carried into the Gulf are equal to a prism one mile square by 263 feet thick, besides heavier matters which are pushed along the bottom equal to another square mile 27 feet thick:* so that for many miles from its mouth, the Gulf of Mexico is coloured brown by the river water. The delta of the Mississippi is also perceptibly increasing in size, and the bar at its mouth is estimated to travel out to sea at rates varying from 20 to 100 yards a year.† As new bars are successively formed to seaward of the old, the sediment which formed the old one is again lifted up by the current and carried further out to sea.

The natural bar of the Mississippi had only 15 feet of water upon it,§ but this has been increased to 30 feet by engineering works, executed by the United States Government since 1875. The rise of the tides, which generally affords such material aid to shipping in the passage of bars, is here unfortunately very small, the vertical rise of spring tides on the S. W. passage being only $1\frac{1}{2}$ feet.** This has therefore always created a great obstruction to navigation, for

* *Encycl. Brit.*, 9th Edition., Vol. xvi., p. 520 (Art. "Mississippi River").

† *The Physical Geography of the Sea*, by Lieut. M. F. Maury, U.S.N., 16th Edition, 1877, p. 190.

§ *Ibid.*, p. 190.

** Norie's *Navigation*, 21st Edition. Table xvii, *Times of High Water at Spring Tides*, p. 354.

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ships entering the Mississippi, but the moment that a vessel is inside the bar she is in deep water, quite four or five times the depth of that on the bar. *

Sir Charles Lyell in his remarks upon Mississippi phenomena notices the fact, that strikes every observant traveller, that the Mississippi is a river having a nearly uniform breadth from its mouth to St. Paul, a distance of 2000 miles from the sea, and Sir C. Lyell asserts that this majestic river for considerable sections of its course cuts a bed for itself out of the soil to a depth of more than 200 feet below the top of the bar, which obstructs its entrance to the sea. †

The depth of portions of the channel of the Mississippi is often very great, sometimes even amounting to as much as 250 feet, while at other points obstructions occur which seriously impede the safe navigation of the river, owing to the fact that throughout its great alluvial plains-track the stream is continually shifting its course. Steamers ascending or descending the river must therefore be guided by river pilots, who have intimate local knowledge of these changes, as banks frequently form, which sometimes entirely close the old channel, while the current rapidly excavates a new one in another place. A large number of changes occur in this way every season and require constant watching by specially trained pilots, especially upon the Missouri.

Another of the dangers incident to navigation on the Mississippi-Missouri system is that arising from what are known as "snags."

* *Physical Geography of the Sea*, by Lieut. M. F. Maury, U.S.N., 16th Edition, 1877, p. 190.

† *Principles of Geology*, by Sir Charles Lyell. Edition of 1867, Vol. i., pp. 440—1.

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In former days, when the river was margined by primeval forests, gigantic trees used frequently to become undermined by the falling of the banks, and as these fell into the river they became engulfed by the stream by which in a short time they were completely stripped of their leaves and branches, and often lay entirely covered by water, with their heads pointing down stream, like so many lances poised to impale unwary steamboats.

When a steamer ran against one of these snags the point at once penetrated the lightly built wooden hull, and the pressure of the swiftly on-rushing steamer caused the snag to *rise up* as she came on to it, until the whole fabric of the vessel was sometimes completely transfixed, as a lance will impale a man. The ragged stem of a gigantic pine, forced through the bottom of the vessel by the momentum of a powerful steamboat, which often came crashing with deadly force through state rooms and cabins, crowded with passengers, as may be supposed proved a terribly destructive agent, and immense numbers of Mississippi steamboats have from time to time been destroyed by such accidents. Heavily laden boats transfixed in this way generally quickly sank, and great loss of life from drowning was of frequent occurrence, in addition to numerous and severe personal injuries to people on board the unlucky boats. As the water is too thick to be able to see anything submerged beneath it, it was often very hard to detect the presence of a snag, until the vessel actually struck upon it. The pilots however, who are always perched high above the water in pilot-houses erected for this special purpose, were very quick and clever at detecting indications of danger.

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Snags sometimes bob or vibrate up and down with the force of the stream, alternately showing their ends above water and then dipping beneath it again, but most of them remain permanently below the surface, except perhaps at quite low water.

The presence of a snag however, fortunately generally betrays itself by a peculiar ripple in the water, which to a practised eye serves to mark the danger which lurks beneath. In former days, before the heavy forest was cut down, when snags were much more numerous than they are at present, it was sometimes necessary to lay boats up at night in the worst parts of the river, where these sunken obstacles were known to be numerous, as no amount of watchful care could detect their presence in the darkness, and the terrors of a possible snag, at any moment coming crashing through cabins occupied by sleeping passengers, proved something more than even the nerves of the reckless Yankee could endure.

Ever since the introduction of steamboats upon the Mississippi, their history has been marked by numerous disasters and incidents, replete with thrilling adventures and hair-breadth escapes, from wrecks, fires, and boiler explosions. The dangerous system of racing between the boats of rival companies accounts for most of the latter class of these so-called accidents, but the flimsy construction of the boats themselves, generally built (at least in former days) entirely of pine, rendered a swiftly moving river-boat about as combustible a collection of materials as could well be imagined. These disastrous conflagrations, it is generally supposed, mostly arose from sparks proceeding from the wood fires, falling from the smoke-stacks (as they were termed) among

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the cargo, which, being fanned by the breeze, quickly converted the entire vessel into a raging mass of flames, in which hecatombs of victims frequently found a fiery tomb, or were swept away by the swiftly flowing river in the vain attempt to swim to land. The suddenness with which these fires have been known to break out and envelop the boats was sometimes indeed appalling, and left no time for them to run ashore before the pilot was driven from his post by the rush of smoke and flame.

The gloomy roll of some of these catastrophes has nevertheless been occasionally lit up by a ray of glory, in consequence of the deeds of heroic daring and self-sacrifice which have not unfrequently been performed by pilots, engineers and others belonging to these boats, in the desperate endeavour to save the lives of those on board, and more than one instance is on record where these men have actually remained at their posts until burnt alive in the execution of their duty. One well known case was that of Thomas Maynard, a sailor on board a steamer which (in this case) took fire upon the lakes, through whose devotion all on board except himself were saved, he having managed to steer the vessel long enough to run her safe ashore before he himself fell back a lifeless corpse into the flames. Another well told and characteristic story of this kind (very likely founded on the case mentioned above) is to be found among Hay's Pike County Ballads. The hero in this case is supposed to be the engineer of the steamer "*Prairie Belle*," who bears the suggestive name of "Jimmy Bludso," and portions of it are, we think, quite worth transcribing, as a specimen of Mississippi River man-

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ners and dialect. The tale is supposed to be told in reply to a query as to "*What had become of Jim.*"

"Wall no! I can't tell whar he lives,
Becase he don't live you see;
Leastways, he's got out of the habit
Of livin' like you and me.
Whar have *you* been for the last three year
That you haven't heard folks tell
How Jimmy Bludso passed his checks,
The night of the *Prairie Belle?*"

(The ballad then goes on to describe the reckless character which its hero bore upon the river, during life, and thus proceeds.)

"All boats has their day on the Mississip,
And her day come at last.
The *Movastar* was a better boat,
But the *Belle* she *wouldn't* be passed:
And so she come tearin' along that night—
The oldest craft on the line—
With a nigger squat on her safety valve,
And her furnace crammed rosin and pine.

"The fire bust out as she clared the bar
And burnt a hole in the night
And quick as a flash, she turned and made
For that willer-bank on the right.
There was runnin' and cursin', but Jim yelled out,
Over all the infernal roar,
'I'll hold her nozzle agin the bank,
Till the last galoot's ashore.'

"Through the hot, black breath of the burnin' boat
Jim Bludso's voice was heard,
And they all had trust in his cussedness,
And knowed he would keep his word.

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And, sure's you're born, they all got off,
Afore the smoke-stacks fell—
And Bludso's ghost went up alone
In the smoke of the *Prairie Belle*." *

Jimmy Bludso is the type of a hard living, reckless spirit, such as may be found by dozens upon the banks of the great river, their mouths full, it may be, of oaths and other coarse expletives, and yet their hearts are capable of lofty deeds of self-sacrifice at the shrine of patriotism and duty, such as are worthy of all admiration. The epitaph of such a one may be justly summed up, in the words contained in the last verse of this ballad:

"He weren't no saint,—but at jedgement
I'd run my chance with Jim
'Longside of some pious gentlemen
That wouldn't shook hands with him." †

The mighty flood of the great river sweeps onward with great velocity throughout its entire course, eroding its banks in the bends and rebuilding them on the points, and yet the fall of its channel is often very slight for long distances. Thus the Mississippi at the point where the Red River falls into it, 316 miles above "the passes," or sea mouth, is only 5.2 feet above the level of the Gulf of Mexico at the lowest stage of the water. §

"The river channel along this section is therefore a fresh water lake, nearly without islands, 2600 feet wide and 100

* *Pike County Ballads and other Pieces*, by John Hay, Boston, 1875, pp. 17 *et sequitur*.
† *Ibid.*, first four lines of last verse.
§ *Encycl. Brit.*, 9th Edition, Vol. xvi., p. 520.

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feet deep. At the flood state the water rises 50 feet at the mouth of the Red River, but of course retains its level at the Gulf thus giving the head necessary to force forward the increased volume of the discharge." *

We are careful to note this circumstance because it furnishes an explanation of the phenomenon of a resistless torrent, flowing like a mill-race through a dead flat country, such as exists both on the Mississippi and the Ganges during flood time, upon the last section of their respective courses. The Mississippi floods are generally at their highest in April, and the level of the river falls to its lowest point, as a rule, in October.

Sir Charles Lyell gives a careful and accurately prepared account of the Mississippi, which he visited for purposes of scientific observation, during his geological tour in America, and he states that according to the most recent U.S. Government surveys, the area of its delta is about 12,300 square miles. †

The average depth of fluviatile formation in this area is supposed to be somewhat more than 500 feet, for in borings made near Lake Pontchartrain, not far from the city of New Orleans, the bottom of the alluvial deposit was said not to have been reached, even at 600 feet. § This of course goes to show that all this territory has by degrees been built up by the great river, upon what was formerly a deep water area of the Gulf of Mexico. The work of construction is still going on, and year after year the river bar, as we have already explained, is pushed further and further

* *Encycl. Brit.*, 9th Edition, Vol. xvi., p. 520.
† *Principles of Geology*, by Sir Chas. Lyell, 1867, Vol. i., p. 458.
§ *Report of Surveys* of 1861, by Messrs. Humphreys and Abbot.

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out to sea. The formation of the Mississippi delta at its most southern or seaward part, is of the most curious and remarkable character, consisting here of

"a long narrow tongue of land protruding nearly 50 miles into the Gulf of Mexico, and terminating in several arms or 'passes,' which have a fan-shaped arrangement, the S.W. pass (at the time of Sir Chas. Lyell's visit) being that through which all the water was poured out, while each of the others has by turns at some former period been the principal channel of discharge. This tongue of land consists simply of two low banks, covered with reeds, young poplars and willows, and in appearance answers precisely to those of the river in the alluvial plain." *

The principal mouths by which the water finds exit to the sea are the South West pass (spoken of above), the South pass, the North East pass, and the Pass à Loutre; of these the South West pass is that by which sea-going ships enter the Mississippi at present.

An examination of a good atlas will show the exceedingly remarkable character of the formation at the terminal arms of this delta, and will quite repay the reader for a few moments' careful examination. Lake Pontchartrain, the large and curious lake formed to the eastward of New Orleans, is evidently a "cut off," formed by the river out of the bed of the sea.

An enormous area of swamp land extends up along the alluvial plain of the Mississippi for nearly 500 miles from its mouth. These bottom lands have an average width of some 40 miles, and their total area is estimated at about 32,000 square miles, of which comparatively little has as yet been reclaimed. A narrow strip

* *Principles of Geology*, by Sir Chas. Lyell, 1867, Vol. i., p. 447.

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along the river is all that has ever yet been brought under cultivation.

Here therefore is a great region, still almost in a state of nature, which under an efficient system of protection against flood, will doubtless in future years provide an almost inexhaustible field for agricultural enterprise, where an enormous extent of crops of the most valuable character could be raised. It has been estimated that by this means $2\frac{1}{2}$ millions of acres of the richest sugar lands, seven millions of acres of the best cotton lands, and at least one million acres of corn lands of unsurpassed fertility would be thrown open to the use of mankind. *

Well may Americans entertain a boundless faith in the future wealth and greatness of their country! There is no speculation which in the end proves so remunerative as the work of reclamation and cultivation of a fertile soil, and "there is no treasury so reliable as a granary of surplus products." † The precious metals and other arbitrary standards of value may rise or fall ever so much in value, but the rapidly growing population of the earth must be fed, and blessed is the lot of that country whose store-houses are continually overflowing with the surplus garnerings of a bountiful harvest. We say so, in the teeth of the present temporary depression of the agricultural interest.

When the renowned French explorer, the Cavalier De La Salle, first made his famous discovery of the Great West, and issued from the forests upon the

* *Encycl. Brit.*, 9th Edition, Vol. xvi., pp. 518-519. (Art. "Mississippi River").

† *The Commercial Products of the Vegetable Kingdom*, by P. L. Simmonds, 1854, p. 271.

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banks of the majestic Father of Waters * (near the confluence of the Missouri, with the Mississippi) both he and his followers were vastly impressed by the spacious grandeur of the mighty stream which they saw before them, swiftly drifting towards unknown destinies, and embarking upon its waters they floated day after day down its turbid flood, until they reached the ocean.

The earlier discoveries of the Spaniards † had thus far led to little or no result, but La Salle at once appreciated the magnitude of his success. His reports to the French court of Louis XIV. caused the matter to be warmly taken up and the first settlement was thus made on the Mississippi. From that day to this the Mississippi has rapidly increased in importance, as a great highway of commerce from the far interior to the ocean, and is now rightly esteemed one of the leading glories of the American Union. Great in peace, it promises to be no less great in war, and though the defence of its embouchure in some respects presents peculiar difficulties, according to Captain Mahan, U.S.N. (the writer of a recent remarkable work upon "The Influence of Sea Power upon History") the advantages of the Mississippi are such "that the main effort of the country must pour down that valley, and its permanent base of operations be found there," in case of naval operations in the Caribbean Sea. §

If the Mississippi System forms a crown of glory to the United States, another no less noble stream, which

* A.D. 1682, February 6th.

† Under Ferdinand de Soto, 1541.

§ *The Influence of Sea Power on History*, by Capt. A. T. Mahan, U.S.N., 1890, p. 34.

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opens up a waterway of unsurpassed grandeur through the Dominion of Canada, fitly represents the Imperial power of Great Britain in North America.

The mighty river St. Lawrence is one of those rare instances of a river, whose estuary is so perfect in form that it issues unobstructed to the ocean, without the usual defect of a sand barrier thrown up by the lap of the surge at its junction with the stream. Taken in connection with the great lakes, the St. Lawrence affords the most magnificent system of inland navigation in the world, and the approximate area of its basin is estimated at 510,000 square miles, of which 322,500 belong to Canada and 187,440 to the United States. * It is usually accounted that the head-waters of the St. Lawrence are represented by the St. Louis River, which discharges into Lake Superior at Fond-du-Lac; if we accept this as so, the distance from the sources of the St. Louis to Cape Gaspé at the Gulf, is but some 2100 miles. The St. Lawrence is pre-eminent therefore not on account of the great length of the cross section of its basin, but because of its enormous catchment reservoirs—the great lakes. It is however a fact worthy of notice that the River St. Louis, its reputed head, springs from the same plateau in Minnesota, that gives birth to its rival the Mississippi, as well as to another important stream, the Red River of the North, † which is comprised among that remarkable system of inland waters which issue via Lake Winnipeg into the Hudson's Bay, by the Nelson River.

Volumes might be written upon the wonderful physical geography of the great St. Lawrence system,

* *Encycl. Brit.*, 9th Edition, Vol. xxi., p. 177-8. (Art. "St. Lawrence".)
† *Ibid.*, p. 178.

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and the vast chain of inland seas, which form incomparably the largest body of fresh water in the world, which issue by it to the sea.

It may be convenient to give a few technical details respecting these great lakes, which form so striking a feature of the North American continent.

	Area in sq. miles.	Approximate size in sq. miles.	Maximum depth in ft.	Altitude in ft. over sea-level.
Lake Superior	31,200	412 × 167	1008	602
Lake Huron	21,000	263 × 101	702	581
Lake Michigan	22,450	345 × 84	870	581
Lake Erie	9,960	250 × 60	210	573
Lake Ontario	7,240	190 × 54	738	247 *

Lake Huron, as we know, issues by the St. Clair River and Lake, into Lake Erie, and the small lake seen upon the map, located midway between them and marked as "St. Clair Lake," is itself 29 miles long, and has an estimated area of something like 700 square miles.

Then there is the renowned Niagara River leading from Lake Erie to Ontario, over the great falls of that name, whose grandeur fills every spectator with awe and admiration, but whose aspects are so well known that we shall not inflict upon our readers a further description of them. Suffice it to say that the total descent from Lake Erie to Lake Ontario is 326 feet. †

Shipping ascends via the Welland Canal, on the Canadian side, which has a length of 27 miles, and 25

* *Encycl. Brit.*, 9th Edition, Vol. xxi., p. 182.
† *Ibid.*, Vol. xxi., p. 182.

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locks. It is from Lake Ontario that, as everybody is aware, the St. Lawrence River (properly so called) leads down to the ocean. The point of exit is at Kingston, an important town and strategic point of Canadian territory, strongly fortified, shortly below which come the well-known "Thousand Islands" a section of river scenery celebrated for its almost unrivalled beauty. *

From Kingston the St. Lawrence runs a course of about 728 miles to Cape Gaspé, which is usually and as we believe correctly accounted its sea mouth, though some writers have insisted upon regarding the Straits of Bellisle as the true St. Lawrence mouth, which would give it an additional length of about 436 miles. The head of ocean navigation is at Montreal, a point 178 miles below Kingston, and 550 from Gaspé, the river being obstructed by the Lachine Rapids a short distance beyond that town, so that ships have to pass through the Lachine Canal to avoid them. But as far as Montreal large ships can ascend without obstruction. The influence of the tides ascends to Three Rivers, 68 miles above Quebec, where during spring tides a rise of 3 or 4 inches occurs; but their effects soon become totally lost in Lake St. Peter, a short distance above that town. † It is at Quebec however that the large transatlantic steamers usually stop and disembark their passengers. The place itself is full of interest, and all who can do so should make it a point to remain there for three or four days in order to visit the principal points of interest in and around the city.

* What are known as *The Thousand Islands* in reality consist of an archipelago of not less than 1692 islands of all sizes, great and small.

† *Admiralty Sailing Directions*—The St. Lawrence River Pilot, Vol. i., p. 307. (Official Publication).

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The historic fortress of Quebec may be said to be located at the head of the sea estuary of the St. Lawrence, where it stands like a lion in the path to bar the way to all intruders. The position is remarkable both for its enormous natural strength (in consequence of which it has been sometimes termed the Gibraltar of North America) and also for its singular beauty. From its summit where the frowning battlements of the renowned citadel overlook the river from an eminence of some 320 feet, splendid views of forest and river scenery are obtainable, and we feel sure that those who have been privileged to contemplate their unrivalled grandeur will always treasure in their memory the recollection of Quebec, as one of the fairest and most striking scenes that the traveller's eye can meet with.

Nor is Quebec less great in its historical than in its scenic interest, for it was here, as we know, that the issues of the great struggle between Great Britain and France for the Empire of the West were finally decided. We trust therefore we shall not be considered either too tedious or discursive if we venture to invite our reader to accompany us in spirit to the ramparts of Quebec in order to take a brief survey of the surroundings. For this purpose we are supposed to pause for a few moments, looking down from the citadel upon the great river, whose mighty flood bathes the base of the cliff upon which the fortress is perched, which here forms an immense headland rising abruptly out of the swirling waters just at the juncture of the river St. Charles with the St. Lawrence, greatly narrowing the tideway of the last-named river at this point, so that its stream is here but little more than half a mile

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in breadth. The current however runs swiftly, and (as usual in river gorges) its depth is very great, the water abreast the city being 28 fathoms deep, while immediately above it the river again expands to what may then be considered its normal width of a mile and a quarter broad, with a channel still 28 fathoms in depth. Below Quebec, between the city and the Island of Orleans, however, the St. Lawrence entirely changes its character and here assumes that of an extensive basin or roadstead, which forms a commodious harbour, where an immense fleet of the largest ships can lie at anchor. The sea estuary may be said to commence at this point, and the rise of its spring tides is here 18 feet. *

Looking down from the citadel in this direction a noble prospect is spread out before the beholder, as the eye travels over a wide panorama of land and water enclosed in the distance by lofty hills. To the south the fortified bluffs of Point Levi occupy the opposite bank of the St. Lawrence, while the approaches to Quebec from the rear, to the northwards, are guarded by the rocky gorge of the St. Charles River. Eastwards the northern shore is seen covered with numerous villas and white houses which extend down the river to the vicinity of the falls of Montmorenci.

These celebrated falls which plunge over a precipice nearly 250 feet high, close to the point where the river of that name flows into the St. Lawrence, form a leading attraction for visitors, and from above them a splendid view of Quebec in the distance is obtained. It was upon

* *Admiralty Sailing Directions*—The St. Lawrence River Pilot, 5th Edit. 1882. Published by order of the Lords Commissioners of the Admiralty. Vol. i., p. 280.

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these heights that the main body of the British army under General Wolfe first took up their position for the siege of the place in 1759, with their front resting upon the Montmorenci River. The entrenchments of the French troops at that time extended the whole way from the falls to the city, a distance by road usually estimated at about 8 miles.* The original design of Wolfe was to fight his way to Quebec by this route, aided by the fire of the fleet. The attempt however had to be abandoned, and the subsequent attack via the Heights of Abraham, which was crowned with such signal success,† was an afterthought, adopted as a last and desperate expedient, when all hopes of capturing this hitherto impregnable fortress were well nigh extinct.

The great difficulty in the path of Wolfe, upon which Montcalm built his chief hopes of successful defence, was that the approach of winter, and the closure of the St. Lawrence by ice, would compel the British to suspend the attack until the following spring. All accounts tend to show that the severity of the winters in these early days of Canadian history, before the country had been opened up by clearing away the forest, was far greater than anything experienced at the present time, human occupation and the cultivation of the soil having largely modified their former extreme rigour.

Ice upon the St. Lawrence, at present, seldom or never freezes across below Quebec, and only occasionally opposite the city, but the river is full of heavy ice,

* See map of Quebec and its environs in Francis Parkman's *Montcalm & Wolfe*, 5th Edition, 1885, Vol. ii., facing p. 200, and letterpress description of same in *ibid.*, pp. 208-9.

† September 13th, 1769.

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moving up and down with the tides with irresistible force. The regular ice bridge is generally located 5 or 6 miles above Quebec, and from thence upwards, as far as Lake Ontario, the St. Lawrence is everywhere frozen across, except in places where the current is very strong. * Taking the mean of a number of years the navigation is closed by ice at Quebec from the 25th of November to the 25th of April, but in the comparatively narrow channel there the river is kept open by the rapid tides. † The break-up of the ice upon the St. Lawrence in spring is quite one of the sights of the world to witness, as an example of the irresistible power of Nature, and has often been made the subject of description by abler pens than ours. It is generally preceded by loud noises, sometimes almost resembling those produced by the firing of heavy artillery, caused by the cracking of the immense masses of ice, under the constantly increasing pressure of the stream, and finally the great break-up occurs as sudden as the coming of a thief in the night. The iron bonds of winter are loosened and the mighty river flows again. The accumulations of pack ice at certain points are frequently of an extraordinary character; partial break-ups occur during the course of the winter, caused by alterations of the water level created by the tides and by thaws and storms; broken masses of ice thus become heaped up by the pressure of the moving masses, until they form a spectacle of the wildest confusion, of which photographs alone can convey an adequate conception. Once the final break-up however has taken place in

* *Admiralty Sailing Directions*—The St. Lawrence River Pilot, compiled by Admiral H. W. Bayfield, 5th Edition, 1882, Vol. i., p. 282. (published by order of the Lords Commissioners of the Admiralty).

† *Ibid.*, p. 3.

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spring, the ice masses are quickly carried out to sea, and disappear, and the navigation becomes open again.

This sudden transition from winter to spring is one of the most striking phenomena of Canadian life. To-day, the country is one vast expanse of ice and snow: to-morrow the streams begin to flow, the canopy of snow dissolves, grasses and wild flowers immediately begin to make their appearance, and the voice of the bird is heard again, as flight after flight of these beautiful creatures wing their way overhead towards their nesting grounds in the frozen north.

The estuary of the St. Lawrence begins, as we have said, at Quebec, from which point the river gradually expands in shape like the mouth of a funnel, until it reaches the sea. This may be regarded as Nature's most perfect form of river estuary, and the few rivers which possess estuaries thus formed are generally free from bars. Of these the St. Lawrence is undoubtedly the finest example. * Those of the Thames, the Severn and the Scheldt however afford minor instances of the same kind. Proceeding down the river from Quebec, after passing the Isle of Orleans (which we have already mentioned as enclosing the splendid harbour of Quebec), the channel has already expanded to a width of 11 miles, and at the mouth of the Saguenay, 130 miles below the city, it is 16 miles wide. This river is the most important tributary of the lower St. Lawrence, the last 50 miles of its course forming a magnificent estuary, or mountain loch, enclosed almost everywhere

* The estuary of the Congo in Western Africa is however now ascertained to be another great example of a river whose sea entrance is unobstructed by a bar, and the depth of water for some distance up its channel is enormous.

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by precipitous headlands, which rise abruptly from its depths to heights in some places exceeding 1000 feet.

The mouth of the Saguenay is generally held to be one of the finest pieces of cliff scenery in the world, the awe-inspiring grandeur of its beetling precipices and the deep shadows which they cast upon its boiling eddies, have given rise to the most extravagant exaggerations respecting the rapidity of its currents, its whirlpools and unfathomable depths, which were incorporated into the earlier accounts of this river. The Admiralty survey of it, first made in 1829, did much however to dissipate these inflated descriptions, while officially acknowledging the grandeur of its scenery, which though wild and barren is still full of sublimity and beauty. *

After passing the mouth of the Saguenay, as a glance at the map will show, the great river continues growing steadily wider, until at Cape Chat, 260 miles below Quebec, it has attained a width of 30 miles, which then rapidly increases to double that amount, some 30 miles further to seaward. The true mouth of the St. Lawrence is generally placed near Cape Gaspé, a point some 390 miles below Quebec, where the distance from shore to shore is 80 miles, † but this is still a distance of 436 miles before entering the Atlantic from which it is separated by the immense landlocked "Bay of St. Lawrence," which of itself

* See *Admiralty Sailing Directions*—The St. Lawrence River Pilot, 1882, Vol. i., p. 297. Published by order of the Lords Commissioners of the Admiralty.

† The channel is here obstructed by the island of Anticosti. The South Channel from thence to the Gaspé territory at Cape de Rosiere is 45 miles wide. The Channel to the north of the Island to the Labrador coast is only 15½ miles in width.

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forms a sea of no mean capacity and at the south-west entrance to which the Magdalen Islands are situated.

These islands are noted as including in their archipelago two celebrated rocks known to navigators as the "Bird Rocks," which consist of splendid and almost perpendicular cliffs of red sandstone, forming the home of countless legions of sea birds, whose extraordinary numbers have caused these islands to be thus named. From the earliest periods of Canadian history the "Bird Rocks" have attracted the attention of all observers. Throughout the British Colonial records from the time of the conquest downwards they have constantly lived in story, and to all appearance are likely to do so for generations yet to come. So peculiar an object of interest had they become, that 120 years ago, we read, it was quite a usual practice for ships arriving from Europe to salute the august presence of the New World (whose threshold is here guarded by these fastnesses of Nature) with a gun, as the ship neared these historic rocks. * Immediately, we are told, the air was filled with innumerable hosts of birds, whose legions literally darkened the sky, and whose discordant cries swelled into so vast a volume of sound as almost to deafen the spectator.

Contrary to the usual course of history, the descendants of these feathered tribes still maintain their position in apparently almost undiminished numbers. Time has dealt lightly with them, Nature having protected their stronghold from intrusion, by means of inacces-

* See Anbury's *Travels in America*, 1791, Vol. i., chap. i. (The author was an officer in the British service, during the war against the revolted colonies).

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sible cliffs. Admiral Bayfield, compiler of the Admiralty Sailing Directions for ships entering the St. Lawrence, assures us that even still

"every ledge and fissure of the cliffs is occupied by gannets, and the summit of both rocks is literally covered with them. The white plumage of these birds gives these rocks the appearance of being capped with snow, and renders them visible through a night glass, in a clear and moonlight night, for the distance of 7 or 8 miles." *

After passing these islands we at length reach the open sea and glide over the actual borders of that great ocean which for so many ages baffled the efforts of the ancient mariners in their attempts to traverse its liquid expanse, at that time supposed to extend in illimitable magnitude towards the setting sun. Leaving Newfoundland to the northwards, the passenger sails across the great banks of Newfoundland, celebrated for their cod fisheries, concerning which we hope in our section on Fishing to add some details of interest. Meanwhile, as we go forth into the pathless sea we reach the limits which we have laid down for ourselves in our description of the Great River Systems of the World. As we have gone along we have briefly sketched the leading features of what seemed to us a typical series of the most prominent among these "great drainage works" of Nature; and in closing this chapter, we venture to point out the enormous strategic and commercial importance which the control of the principal waterways into the heart of great continents has always exercised upon the past history

* *Admiralty Sailing Directions*—The St. Lawrence River Pilot, 1882, Vol. i., p. 40. Published by Order of the Lords Commissioners of the Admiralty. See also, The Admiralty Chart of The Magdalen Islands—No. 1134.

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of the world. Nowhere has this been more forcibly exhibited than in the case of the river St. Lawrence, the great river whose ship channel we have just described. As long, for instance, as the French held their sea and river communications open, via the St. Lawrence, Great Britain could do nothing against them. Every effort on the part of the latter ended in defeat and failure. But on the other hand the moment the sea power of Great Britain, towards the middle of last century, succeeded in severing that line of communication, the French power in Canada dwindled and finally collapsed in toto. These great lessons ought never to be lost sight of by the British people.

The navy must not merely be regarded as the *first line* of defence to the British Islands. It is that, but is also much more than that; for sea power is the only safe and stable basis of a great Colonial Empire. The sea ought never to be regarded by Britons as a source of weakness, which (as the foreigner delights to put it) *divides* her empire: but rather as a great liquid highway which *unites* every colony and dependency to the mother-land.—That being so—and history is full of precedents which demonstrate the truth of this axiom—it therefore follows, that in the weighty words of a late first Sea-Lord of the Admiralty—

"A navy which is not strong enough to defend our vital interests in time of need, is not worth its cost, whatever it may be; and a navy which is strong enough to defend us is cheap whatever its cost may be. The dearest navy England can have is a weak navy: the only cheap navy, is a navy strong enough to defend her." *

* Precis paragraphs from a letter (signed V) appearing in *The Times* of June 17, 1896, p. 4 on "The Naval Manœuvres."

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We venture to call attention to these precedents, because many of the same questions that met the British in North America 150 years ago seem to be cropping up again to-day: thus the command of the sea and also of the great internal channels of water communication are for instance sure to exercise a high degree of importance in the opening up of the great continent of Africa, through the central portion of which the wild, inhospitable nature of the country and the density of its wide expanse of equatorial forests, places a practical bar upon all other means of communication. So again under the influence of British engineering skill and capital, there can be little doubt that in Egypt a navigable waterway for boats of considerable size will in time be constructed from the Mediterranean to the great Central African Lakes. We have every hope that this will one day be carried into effect, via the River Nile, by our engineers.

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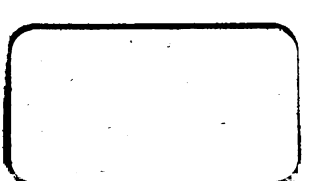

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